The

Tropical Agriculturist

(6) December 1930

EDITORIAL

AGRICULTURAL RESEARCH AND THE FARMER

TWO booklets have recently been published that are of special interest to the more educated agriculturists describing as they do the work of bringing to them and their less erudite, but perhaps none the less intelligent, brethren the information in the possession of Departments of Agriculture.

One booklet is Miscellaneous Publication No. 88 of the United States Department of Agriculture describing its own Growth, Structure, and Functions. The other is the Empire Marketing Board Publication No. 33 upon the Dissemination of Research Results among Agricultural Producers.

The first booklet is a plain but interesting statement of facts from which much can be learnt of interest even for Ceylon. It opens with the statement: "*Though nearly everyone knows that the Department exists primarily to advance the welfare of agriculture in all ways consistent with the welfare of the community as a whole few appreciate the variety of the tasks that this duty imposes.*" When we read this about the most hustling business nation of the world we are surprised that it does not differ more from Ceylon. In America "*Research now dominates all the work of the Department, its service, regularity and educational activities as well as its scientific projects. Useful service must be grounded in scientific knowledge . . . . . We may distinguish between research for more or less well-defined practical objects, and fundamental research for the discovery of basic facts and principles. The first type may be undertaken to throw up a hurried defence against diseases and pests, to develop plant*

varieties or strains of live-stock suited to particular conditions, or to find new uses for crop by-products. Fundamental research is not directed toward any clearly defined practical goal. It explores physical or biological phenomena primarily to increase the sum of knowledge rather than to attain any specified tangible advantage. This does not mean that fundamental research is not practical. It is practical in the highest and most permanent sense. Time and again fundamental research has developed facts or principles of revolutionary practical importance."

The American Department of Agriculture administers some fifty regulatory statutes controlling the quarantine of animals, the inspection of meat, the supervision of viruses, serums and toxins, the preparation of butter, the exclusion and control of pests, the importation of tea, milk, and many other things. We are glad that we in Ceylon have fewer controlling regulations to administer. Regulatory work is essential to eliminate or prevent social hazards, waste of resources, and economic abuses, and to prevent the introduction into a country or spread within it of diseases and pests. Regulatory work in connection with agriculture is very necessary but at the same time never very popular amongst those requiring regulation, and these facts add considerably to the difficulty of its administration.

Sir Daniel Hall in his Introduction to the Empire Marketing Board Publication makes some remarks that may astonish many: "*It may almost be said that an acquaintance with results of research proper is of no use to the farmer, who needs only to be supplied with some of the deductions and consequences . . . . . The results obtained by the Experiment Stations should, however, reach the staff of instructors who deal directly with the farmers. As these instructors are scattered and busy men it is of importance to organise some means of keeping them in touch with developments of their subject.*" In a special category we are told must be placed the general information about improved farming which the ordinary cultivator requires. "*Research is not involved; the men in question, and they constitute the great majority of practical producers, fail in that they are not utilising common knowledge scientific or practical.*" When half the people in a country reap less than half the average yield of a crop and the other half reap more than twice the same average the problem is not so much "how to bring home the results of recent research but the common facts upon which their calling is based—practical, scientific, and economic."

This is in very large measure our problem in Ceylon. It is a duty that our agricultural instructors require to take seriously in hand, to simply help with many common practices and processes connected with husbandry. More instruction and less inspection is required. "The less intimate the personal contacts the less effective the education will be."

FOURTH AGRICULTURAL CONFERENCE AT PERADENIYA—*(Continued)*

SOME NOTES ON THE PADDY FLY IN CEYLON

J. C. HUTSON, B.A., PH.D.,
ENTOMOLOGIST,
DEPARTMENT OF AGRICULTURE, CEYLON

THOSE of you who are interested in paddy cultivation will have read the reports of the various Sub-Committees with much interest and you will doubtless have noticed that most of them allude to paddy fly as being the most important insect pest of paddy in Ceylon. You may perhaps have wondered why it is that, no matter at what time of the year paddy crops are maturing in any given district, paddy fly is usually present in sufficient numbers to cause appreciable damage to the maturing grain, except perhaps when there is a strong dry wind on the northern and eastern sides of the Island.

I propose therefore to indicate, as briefly as possible, some of the reasons for the general prevalence of paddy fly (*Leptocorisa varicornis*) throughout the year and for its importance as a pest and to touch on certain possible control measures, and in doing so I shall draw mainly on our previous knowledge of this pest obtained from investigations carried out by Mr. G. D. Austin of the Entomological Division some nine years ago at Anuradhapura and given in Bulletin No. 59 of this Department. Brief allusions will also be made to the opinions expressed by Agricultural Officers of this Department in reply to a questionnaire on paddy fly sent out last year, and to the information about the pest given in the recent reports of the Sub-Committees.

With regard to the investigations, it was unfortunate that these could only be carried out for a period of about six months from December 1920 to June 1921 and that they had to be abandoned just as they were reaching an interesting stage. There is still a lot more to be learnt about paddy fly and it is hoped that it will be possible to resume the work later, with special reference to the possibilities of controlling this pest by means of its natural enemies, as one or two of the Sub-Committees have recommended in their reports.

The following are among the more important reasons for the general prevalence of paddy fly throughout the year in paddy districts, so far as our investigations have indicated at present:

1. Both nymphs (young stages) and adults can feed on several species of common wild grasses and cultivated plants when paddy plants are not available. Among the wild grasses may be mentioned *Panicum colonum* and *Cyperus polystachyus*, two of the favourites, and about 8 other species, while among cultivated plants are kurakkan (*Eleusine Coracana*), Amu (*Paspalum scrobiculatum*), tanahal (*Setaria italica*), green gram (*Phaseolus Max*), cowpea (*Vigna catiang*), and species of *Crotalaria* and *Amarantus*. Probably this list could be increased considerably by further investigation. Paddy fly is said to breed freely in jungle areas, and this requires confirmation.

2. Both sexes can survive for several weeks on paddy and on at least one species of wild grass. During the investigations both sexes were kept alive for at least 14 weeks on paddy and *Panicum colonum*. Further experiments would probably indicate their ability to survive for long periods on other grasses and cultivated plants.

3. Paddy fly can aestivate, or remain dormant, during hot dry periods, possibly with a minimum of food. Observations made at Anuradhapura indicated that during the hot dry months of February and May 1921 the bugs retired to areas of weedy growth or low jungle, especially where the ground was damp or swampy. Further observations on aestivation are needed. Incidentally it may be mentioned that bagging operations with hand nets indicated that paddy fly shows a marked preference for damp or water-logged areas during hot dry weather, as a reference to Bulletin No. 59 page 7 will show.

4. Female paddy flies, after becoming full-grown, can, if supplied with food, remain for periods of from 2 to 10 weeks without laying their eggs, the normal pre-oviposition period being about 3 weeks. Field observations at Anuradhapura showed that, while the bugs were inactive during the hot dry months of February and May 1921, as soon as rains came they began to feed actively, mate and lay eggs. This seems to indicate that the females can withhold their eggs until conditions of food, and possibly of moisture and temperature, are favourable.

5. Under favourable conditions paddy fly can breed rapidly on paddy and on at least one species of wild grass, namely, *Panicum colonum*. Life-history experiments at Anuradhapura indicated that *Leptocorisa* can pass through a complete life-cycle from egg to adult in about 24 days in captivity and it is possible that under field conditions the life-cycle may be shorter, say 3 weeks. Allowing 3 weeks to elapse until the first eggs are laid for the next generation we get a period of about 6 to 7 weeks from egg to egg.

6. The probable scarcity of any efficient natural enemies of paddy fly.

During the course of the investigations at Anuradhapura an egg-parasite was found in small numbers while three species of predaceous bugs were frequently observed feeding on both nymphs and adults of *Leptocorisa*. The most important of these was *Asopus malabaricus*. No birds were ever observed to feed on paddy fly, which is probably distasteful to them. In this connection it may be mentioned that Mason and Lefroy in the course of a thorough investigation into the food of birds in India, during which the stomach contents of several hundred birds from over 100 different species were examined, found no instance in which *Leptocorisa varicornis*, our paddy fly, was taken by birds. It is doubtful whether any of the animals known to visit paddy fields would feed on paddy fly, owing to the pungent odour which it gives off when disturbed. As previously indicated considerable further investigation is needed on the natural enemies of paddy fly.

The above observations will serve to emphasise that the importance of paddy fly as a pest lies mainly in its ability—

(1) to survive unfavourable conditions when the food supply is low and when there is little or no paddy available in any given area;

(2) to keep back its eggs until conditions are favourable for breeding; and

(3) to invade paddy areas in sufficient numbers and start breeding rapidly just at the time when its damage will be most serious, that is, during the maturing period of the crop, starting from the flowering stage. In this connection it may be of interest to note that, at the Experiment Station, Anuradhapura, during 1921, when paddies were maturing several times a year each maturing period (starting from the flowering stage) was accompanied by an invasion of paddy fly.

Before passing on to brief notes on possible control measures, some allusion may be made here to the influence of climatic conditions on paddy fly, and to the incidence of this pest in relation to the varying conditions of paddy cultivation.

INFLUENCE OF CLIMATIC CONDITIONS

In a few of the reports of the Sub-Committees attention is drawn to the absence of the fly from the paddy areas during strong winds, especially the hot dry wind which blows during the south-west monsoon on the northern and eastern sides of the Island. It is possible that at such times this

pest goes into aestivation, as was found to be the case at Anuradhapura during hot dry weather. Some of the Agricultural Officers have observed that paddy fly is disturbed by heavy rains and it is not unlikely that many of the nymphs are washed down and drowned in the fields.

INCIDENCE OF PADDY FLY

The replies to the questionnaire on paddy fly in relation to paddy cultivation indicate that cultivators are quite aware of the damage caused by paddy fly and that they seem to have realized from long experience that the severity of the attack can be lessened if they can manage to grow over a large area those varieties of paddy which will flower and mature about the same time. The result of this system of cultivation seems to be that the paddy fly becomes more or less evenly distributed over the whole tract of paddy and the damage to the crop is comparatively slight. If the north-east rains are early or irrigation facilities are assured for that particular crop then long-aged paddies of approximately the same maturing age are usually sown over fairly large areas, but if the monsoon is late or an adequate supply of irrigation water is not available in good time then shorter-aged paddies are grown. In either case, provided that the paddies, whether short or long-aged, flower and mature together, and provided that a fairly large area is grown, the damage done to any one variety is slight.

Several of the reports call attention to the fact that paddy fly damages a late crop or a crop sown at wrong seasons, and indicate that for various reasons, such as the irregularity of the monsoon, the lack of sufficient irrigation facilities, (*i.e.*, supply of water, attention to drainage or the removal of flood water), the shortage of buffaloes, the counter-attractions of chenas or of estate work, the cultivators may not get their paddy sown at the right time.

As a result of these uncertain conditions cultivators may grow at the last moment whatever paddies are available or they may leave large areas uncultivated. In any case the areas of paddy grown under such conditions are comparatively small and scattered and may be maturing at different times in the same locality, with the result that severe damage is usually done by paddy fly. One or two of the reports refer to the heavy attacks of this pest on small isolated areas of paddy surrounded by jungle, notably in the Trincomalee district and in the North-Central Province and suggest or imply that the heavy infestations may be due to the invasions of the pest from jungle areas where it is said to breed. The above points are of much interest and require further investigation both from the agricultural and the entomological sides.

CONTROL MEASURES

The control measures recommended at various times for the control of *Leptocorisa* may be grouped conveniently under preventive and remedial measures.

Preventive measures are mainly the clearing of grasses and weeds from around paddy areas and in adjoining uncultivated areas before the maturing of the crop. The object of these measures is to deprive paddy fly of some of its main sources of food supply outside the paddy season and prevent it breeding in large numbers just before paddy reaches its attractive stage. Incidentally the control of grasses will also keep down other pests of paddy, such as the swarming caterpillar. If it is true that paddy fly and other insect pests of paddy breed in jungle areas then the above remedial measures are hardly likely to be effective for small areas of paddy grown near jungle, as for instance in the Trincomalee district and in the North-Central Province.

Nowhere can it be said that any serious attempt is made to keep down grasses and weeds. Cattle are sometimes grazed in the paddy fields after harvest.

Remedial measures recommended include the use of hand nets and of winnows smeared with some sticky substance to catch bugs already in the fields. Both of these appliances gave good results at Anuradhapura during the investigations. So far as is known hand nets have not been used since then except occasionally on paddy stations or in demonstrations to cultivators. Sometimes in the Negombo district winnows on long poles are smeared with jak juice and waved over the plants to catch the bugs.

The cultivators in some districts usually have their own methods by which they hope to control the pest or drive it away. Such measures include the use of sticky ropes to catch the "flies" or ropes smeared with fat or grease to keep them off. Bonfires are occasionally lit near paddy fields to attract and destroy the paddy fly, while smoky fires, sometimes with strong smelling substances, are said to act as repellents.

The use of charms of various kinds seems to be universal in paddy districts. These include the reciting of incantations and the sprinkling of powders over the fields. Special men are employed on these occasions and being good opportunists and psychologists they doubtless arrange to synchronise their operations as nearly as possible with the disappearance of the pest, whether it be paddy fly or swarming caterpillar. It cannot be said, however, that any of the above methods usually employed by cultivators have any real effect in reducing the numbers of paddy fly.

The reports of the various Sub-Committees have emphasised the unsatisfactory conditions under which paddy is grown in most districts and until the conditions of paddy cultivation and the financial position of the cultivators themselves are improved, it cannot be expected that they will respond to any suggestions for organised control measures.

Meanwhile, it seems to be essential that the paddy fly investigation should be taken up again as early as possible, with special reference to the control of this pest by biological methods.

If it is later shown to be possible to breed and distribute the natural enemies already known to be present in Ceylon or if others can be imported from abroad, then it may be possible, with the help of organised campaigns, to prevent the pest breeding in such large numbers as to be one of the limiting factors of paddy cultivation in many districts.

SOME DISEASES OF PLANTAINS IN CEYLON

MALCOLM PARK, A.R.C.S.,
ACTING MYCOLOGIST,
DEPARTMENT OF AGRICULTURE, CEYLON

IT is proposed to review briefly some of the more important of the diseases known to affect plantains in Ceylon. Of the diseases to be considered the first is by far the most important economically and will therefore be discussed in greater detail than the others.

BUNCHY TOP DISEASE

Bunchy top disease of plantains (*Musa paradisiaca* L.) is known in Fiji, Australia, Egypt and Ceylon. It was first recorded in Fiji and it is possible that infected suckers were exported from thence to Australia, Ceylon and Egypt. In Australia severe losses have been caused by the disease which almost wiped out the banana industry in many centres in north-eastern New South Wales and south-eastern Queensland.

In Ceylon the disease first made its appearance in the Colombo district in 1913. Since then it has spread to the majority of the plantain-growing districts in the Island; during the earlier part of the last decade it proved a limiting factor to the growth of plantains on a commercial scale in the Central and Western Provinces. Recently there has been a revival of plantain growing in those districts in which the disease caused so much damage previously and it is urged that efforts be made to prevent a recurrence of the earlier losses. The disease has not yet been recorded on plantains grown in the Tissa area.

In addition to the plantain the disease also affects Manila hemp (*Musa textilis*) and probably occurs on other plants of the same family.

SYMPTOMS

The symptoms of "primary" infection, *i.e.*, infection of suckers when symptoms are displayed from the first emergence from the ground, are best known. The leaves of a badly-infected plant are bunched together at the apex of the plant to form a rosette. Owing to the failure of the leaf stalks to elongate, the leaves stand more erect than normal. Infected plants are markedly stunted, there being little growth in height once the plant is diseased. In Ceylon diseased suckers never mature and

never produce fruit. Such suckers usually receive infection from the mother plant before being removed from the parent stool and it is by means of such infected suckers that the disease is often spread from one locality to another.

"Secondary" infection is the term given to infection which takes place on plants which have hitherto been healthy. The ultimate results of secondary infection are very similar to those described above but it is possible to distinguish the disease in the early stages and by prompt adoption of control measures to remove possible sources of infection of neighbouring healthy plants. The external symptoms of the disease appear in the leaves. The first definite symptom of the disease is the appearance of the youngest unfolded leaf of irregular, dark-green streaks about $\frac{1}{30}$ inch wide along the secondary veins on the underside of the lower portion of the leaf-blade, along the leaf stalk or along the lower portion of the midrib. These streaks are more obvious in some varieties than in others, and apart from the streaking such leaves are normal in size, shape and behaviour. The leaf next to appear displays more marked symptoms. It begins to unroll from the top, giving the partly-unfurled leaf a funnel-shaped appearance; it is slightly smaller than normal, displays more marked streaking and the margin of the leaf-blade is wavy and slightly rolled upwards.

The presence of streaks is the most reliable and definite first symptom of bunchy top disease. In order to see the streaks best the leaf should be inspected from the under-side so as to allow light to pass through it. The youngest leaf of a plant should be examined.

CAUSE OF THE DISEASE

It has been found that the sap of plants showing symptoms of bunchy top disease contains an active principle or "virus" which, when transmitted to healthy plants by the banana aphis (*Pentalonia nigronervosa*), is capable of causing the disease. The aphis is a small sucking insect which lives between the leaf-sheaths of plantains and which at certain stages of its life-history is capable of flying from one plant to another. The insect sucks the sap from a plant and if transferred from thence to another plant it introduces sap from the first into the second plant. It is in this manner that the "secondary" type of infection takes place, *i.e.*, infection of a plant which has hitherto grown normally. The disease is systemic in nature and if one part of a stool becomes infected the disease will in time pass to the whole stool. It is therefore of importance that suckers from a stool containing plants displaying symptoms of the disease should not be used as planting material. As far as we are aware, the disease is only transmitted from stool to stool through the agency of the insect as described above.

Experiments carried out at Peradeniya have demonstrated clearly that bunchy top disease can occur in the absence of the root-destroying organisms which have in the past been stated to be contributory factors.

TREATMENT

The systemic nature of bunchy top disease and our imperfect knowledge of the nature of virus diseases render impossible direct control measures against the virus. Again the aphis which has been shown to transmit the disease is difficult to control under field conditions; it lives in such positions on the plant that spraying is of little use. Of the large number of aphids present in a well-cultivated garden it is unlikely that more than a very small proportion would be infective, *i.e.*, very few would contain in their bodies the infective principle or virus, and apart from transmitting bunchy top disease the damage done by these insects is slight.

The treatment of bunchy top disease must therefore consist in eradication of all diseased plants. The first essential for successful treatment is the recognition of the early stages of the disease. It has been stated above that the nature of the disease is such that, if any one sucker of a stool is infected, the infective principle or virus may pass to all the other suckers or plants in that stool. It is most important, therefore, when a sucker is found to be infected, that the whole of the stool be destroyed. It is false economy to leave the remainder of the stool in the hope that a bunch or bunches will be produced. The risk of leaving infected plants is so great that complete eradication of the stool is the only safe method of treatment.

The disposal of diseased plants is best accomplished by cutting them up into small pieces and allowing them to dry, after which they should be burned or buried as soon as possible. The most satisfactory method of cutting appears to be into thin longitudinal slices which would dry rapidly.

The treatment of diseased plants may be summarised thus:

1. Remove the whole stool containing a plant or plants showing symptoms of disease;
2. Cut up all plants of that stool into thin longitudinal slices and dry as rapidly as possible;
3. Destroy by fire if possible or bury in deep holes.

GENERAL

Especial care should be exercised in the choice of planting material. Suckers for planting should be taken from disease-free areas or at least from parent plants which show no sign of disease. The importance of using good healthy planting material cannot be too strongly stressed.

ANTHRACNOSE OF IMMATURE FRUITS

In wet weather plantain bunches are sometimes affected by a disease which makes its appearance soon after the fruit has set. The disease may be confined to one or two hands of the bunch or may affect the whole bunch. I have here some specimens, photographs and paintings of diseased fruits which will doubtless be sufficient to enable those of you who are familiar with plantain-growing to recognise the disease.

The disease is recorded from India, Porto Rico, and the Philippine Islands. In none of these countries has it proved to be very serious, although in India it was found to be sufficiently important to warrant experiments for control. In Porto Rico the disease is reported to have been more serious at high altitudes than in low-lying situations; such has not been our experience in Ceylon. The disease was first recorded in this country by Petch in 1915 and, while its occurrence is not widespread, it has been reported on a number of occasions, particularly from the Kegalle district. The ash plantain has been found to be the most susceptible variety.

The appearance of the disease on young fruits is typical. Infection may begin at the flower end which becomes black, the disease spreading to involve the whole fruit which becomes black and shrivelled. Sometimes infection takes place from the stalk, infected fingers turning black progressively from the point of infection. It would appear that the latter type of infection, *i.e.*, originating in the stalk, is the commoner in this country. The result is the same, the fruits being black and shrunken. The disease is confined to the fruits and to the fruit-stalk.

The fungus causing the disease is known as *Gloeosporium musarum* and the spore-masses or acervuli of the fungus can be seen on the small shrivelled fruits. The spore-masses are at first moist and bright pink and on drying become a dull light pink. Inoculation experiments have shown that the fungus is capable of causing the disease only after wounding the fruit and then only under damp conditions. The fungus is common on plantains and it would appear that special conditions are necessary before active infection can take place.

In India the disease has been controlled satisfactorily by spraying. At the beginning of the wet season developing fruits were sprayed with Burgundy mixture and the spraying was repeated once a month until the fruit was picked. In addition to spraying, other precautions were considered to be necessary for checking the disease. When all the "hands" were opened the fruit stalk was cut off as far as the last hand, in order not to leave any part of the fruit stalk on which the fungus might live saprophytically.

The disease is not of sufficiently common occurrence in Ceylon to warrant general spraying. It may be found, however, that the disease occurs regularly in certain areas in which case spraying should be adopted. There appears to be no reason why Bordeaux mixture or a lime-sulphur spray should not be used with as great success as Burgundy mixture. General measures such as prevention of injury of young bunches and the removal and destruction of plant debris will tend to reduce the incidence of the disease. All diseased fruits should be removed and burned immediately they are seen.

BACTERIAL DISEASE

A disease of plantains has been reported on two or three occasions, which corresponds closely with the disease known in Trinidad as "Moko" disease. The disease has not as yet been fully worked out in Ceylon, chiefly on account of the difficulty in obtaining specimens in the early stages of the disease. I am mentioning it now in order that those of you who are interested in plantain cultivation may be able to recognise the disease and I trust that you will inform me if you find it.

The presence of the disease is usually detected first in the older leaves. The leaf-blades droop a little more than usual and have a slightly yellowish tinge, symptoms rather similar to those caused by drought. This is followed by a very typical collapse of the leaf-stalk just at the base of the leaf-blade. The leaf hangs down and is followed in quick succession by the other leaves which break down in a similar manner. Eventually the youngest leaf bends over and the plant dies and rots. On cutting across the pseudostem of an infected plant the vascular strands leading from the leaves are found to be dark brown and filled with bacterial slime. The disease may pass from diseased plants into younger suckers until the whole stool is affected.

The disease in Trinidad was found to be caused by *Bacillus musae*. In Ceylon, a bacillus was isolated from diseased plants but this organism failed to reproduce the disease when it was inoculated into healthy plants. We are therefore not yet sure that the disease is the same as that in Trinidad.

The disease is reported to be rapid in action and prompt measures are necessary to keep it in check. Affected stools must be dug up and destroyed at once and care exercised in the selection of suckers for planting.

WILT DISEASE

A disease has been reported on two occasions from the Southern Province which displays symptoms very similar to those described for the Panama disease of bananas. Panama disease has for the last twenty years been widely prevalent on bananas in Central and South America and has had very serious economic effects.

Panama disease is caused by the fungus *Fusarium cubense* which enters the plants from the soil either by way of the roots or through wounds produced in the removal of suckers. The fungus enters the vascular system of the root stock and interferes with the water supply of the plants by causing a breakdown of the walls of the conducting vessels. The external symptoms are those which follow a stoppage of the water supply, *i.e.*, they are the characters of wilting. The leaves turn yellow and dry up in succession. Another symptom is the splitting of the outer leaf-sheaths. The internal symptoms are more definite. A longitudinal section through the base of the pseudostem corm shows that the vascular bundles are discoloured and are yellow, orange or red in colour.

The wilt disease in Ceylon has been found only in isolated instances and it is possible that it is not the same as the Panama disease. On the other hand it may be that the disease is the same but that in this country the virulence is not so great as in Central America. There is a certain degree of immunity to the disease in some varieties of plantains. In any case, it would be well if plantain growers were aware of the possible presence of a dangerous disease and if suspected plants were reported immediately.

DISCUSSION

Mr. M. R. Jebaratnam spoke to the efficacy of the methods recommended by Mr. Park from his experience in Batticaloa, where he said, in 1924, an outbreak of bunchy top was successfully dealt with by those methods.

Mr. Cyril De Mel pointed out that in the case of the small-holder it was difficult to adopt the methods recommended in the paper. Where a large landowner planted a large acreage with plantains as a catch crop he probably took the precaution of getting his plants from areas where the disease had not broken out or which were free of the disease. In the case of the villager, who grew plantains as a money crop, as in the Matale and Rambukkana districts, the crop had been given up owing to bunchy top. Just as it was not practicable to use the hand net in dealing with the paddy fly in paddy fields of thousands of acres, so in plantations of 80 to 100 acres they could not expect diseased groups of trees to be cut and buried with lime as officers of the Department advised villagers to do. There was the cost of carrying out the advice to be considered. They did not get a sufficient response to their efforts and there were some who had even suggested legislation. In the Matale district the incidence of bunchy top was very heavy and in gardens over 20 per cent. of the affected plants were still standing. The growers knew what to do but would not do it, either because they were single-handed or had not the time, being engaged in other occupations. The industry was going out and whether much could be done he had his doubts.

Dr. C. H. Gadd said that any method of treatment of any disease was dependent entirely on actual knowledge of its cause, and the Department in being able to demonstrate that bunchy top was actually a virus disease and was transmitted by the aphis, had made a big step forward. It was suspected for some years that bunchy top was a virus disease but

suspicion was rather different from demonstration. Another point Mr. Park had brought forward, which he considered important, was what he termed the secondary symptoms of bunchy top. He had been able to show that the plant was infected before it began to show the major symptoms of bunching. He did not know whether the Department had been able to show that the plant in that stage before it actually bunched and merely showed streaking of the leaves, was able to infect neighbouring plants through the medium of the aphis. If it was infectious, feeding on a plant which was not bunchy, showed that the symptoms would infect other plants. He thought the ability to distinguish whether that plant was diseased was of importance, but he did not think the villager would understand it, if told about it; it would have to be demonstrated to him. This was a matter which could be taken to the villages by means of agricultural officers and plant pest inspectors.

It was rather disquieting to hear, Dr. Gadd added, that the Panama disease or a disease similar to it existed in Ceylon. This was reputed to be one of the worst diseases of the plantain and, he thought, some attention should be given to it to determine whether it actually was *Fusarium cubense*. It was quite possible our plantains were more or less immune from that disease, but it was possible also that the fungus was there and may acquire the ability to attack plants.

Dr. Gadd endorsed the appeal of Mr. Park that growers of plantains should bring to his notice diseases of this kind: it was quite impossible for the mycologist, deep in research, to have knowledge of outbreaks in various parts of the country unless reported to him. Plantain growers could help themselves to a large extent by bringing outbreaks to the notice of officers responsible for their investigation.

Mr. R. Smerdon asked whether the aphis could be controlled by spraying as in the case of fruit trees and roses.

Mr. Park said that the difficulty of spraying was the conditions in which it lived. It had been tried in Australia with fair but not full success.

Mr. L. Lord asked whether it was necessary to dry the cut stem before burning or burying. It was much easier to get the cultivator to bury them than dry and then bury them.

Mr. Park said he recommended drying because any aphis present on them would be automatically destroyed. In mere burying there was danger of the aphis coming up from the soil as was known to happen in other cases.

To a question by Mr. Smerdon, Mr. Park said that plants put in where infested stools had been removed would not be infected.

Mr. J. C. Drieberg gave his experience at the Farm School. He said that suckers were obtained from Jaffna, Trincomalee, and Rambukkana. The two first were free of disease but the last was diseased. He had the whole plant removed and rubbish burnt in the pit daily for a week. Healthy stools were planted in the same spot and there was no sign of disease at the end of two weeks, but the health of the budding plant was kept up with liberal applications of ash, which perhaps helped it to withstand any disease. The disease was completely eradicated and they had had no signs of it for the six years they had plantains.

TENANCY SYSTEM IN THE BATTICALOA DISTRICT

C. RAGUNATHAN, DIP. AGRIC. (POONA),
ASSISTANT REGISTRAR OF CO-OPERATIVE SOCIETIES

THE question of tenancy in this district is so antiquated that I feel it necessary to acquaint an audience like you with the system so that you may visualise the difficulties that confront the cultivators under modern conditions. One of the main factors that always influence a cultivator either for intensive or extensive cultivation is the facility afforded by the system of tenancy.

There are as a rule three forms of tenancy existing in various parts of the world: namely, (1) for life, (2) for fixed periods, (3) at will. The first two forms are bound to encourage the cultivator to resort to improved and scientific methods of cultivation as the benefit of his labours will not be shared by anybody else, while the third method induces the cultivator to take the most out of the soil, without replenishing the soil in turn with elements that are wanting, as he is uncertain of his tenancy. This last system has failed in all advanced countries and is gradually being replaced by one or the other of the first two systems.

There are three systems in vogue in the Batticaloa District: (a) Muthoddu Mullaikaran, (b) Koottu System, (c) Cooly System.

(a) *Muthoddu Mullaikaran.*—This system is more in evidence in Munmari or Maha lands, and partly, in Pinmari or Yala lands. The second and third are in Kalapogam lands. In the first system 20 per cent of the land has to be cultivated for the landlord, 5 per cent for the head cultivator, and 10 per cent for the other cultivators. All expenses, from the time of ploughing to the time of threshing, have to be met out of the remaining 65 per cent. If there is any balance, after meeting all these expenses, it is divided equally among the cultivators only. This, in theory, may be attractive to the cultivator, but in actual practice, unless there is a bumper crop, the cultivator is always left indebted to the landlord as the latter makes all advances for expenses in kind and charges interest at 50 per cent.

(b) *Koottu System.*—In the second system the landlord not only gives land but also advances all expenses and paddy for the consumption of the cultivator and charges interest at 100 per

cent for the latter at harvest; but the cultivator is entitled to two marakals per amunam or $6\frac{2}{3}$ per cent on the gross yield. After deducting all expenses for cultivation and the due shares to the cultivators on gross return, the balance is divided equally between the landlord and the cultivator. This also may look attractive but in the end the position of the cultivator is not in any way better than it was under the first system.

(c) *Cooly System.*—In the third system the cooly offers to work an area of 4 acres for 15 bushels of paddy as cooly-hire on condition that the seed paddy, fence, and buffaloes are supplied by the landlord. In addition to this the cooly gets 12 bundles of sheath at the time of threshing. This system, I am informed, is becoming more popular among the cultivators.

From the above brief summary it is clear that all these three systems are not systems of permanent tenancy. In short, the tenants are all tenants at will.

Apart from the disadvantages of the system of tenancy the landlords are the financing agents for all expenses of cultivation and recover their advances at the rate of 50 to 100 per cent in kind at harvest. In other words tenancy and credit are so interwoven in this district, more so, than in any I have known.

An important point to be borne in mind in this connection is that the cultivator borrows when the price of paddy is high and repays when it is at its lowest. The source from which he borrows is the landlord. The recoveries of the value of the advances of the landlord plus his interest are made in kind irrespective of whether the loan is given in kind or money. Consequently, the tenant is gradually becoming more and more indebted, even under modern economic conditions, as the system of credit and tenancy, which were suitable in the olden days when things were exchanged in kind, is being persisted in.

The question naturally arises as to what should be done to finance these cultivators at reasonable terms.

The only salvation lies in a system of co-operative credit. I regret that this form of credit has not made much headway in this district for it lags behind many other districts where the conditions for co-operative credit are even not so ideal. Until the Batticaloa Muslims and Tamils realise that their salvation as agriculturists lies in the field of co-operation, it is my humble view that, it is useless to criticise the Irrigation and Agricultural Departments which are working against great odds.

The existing tenancy system is out of place amongst the economic conditions of modern times.

LIVE-STOCK IN CEYLON

M. CRAWFORD, M. R. C. V. S.,
ASSISTANT GOVERNMENT VETERINARY SURGEON

A consideration of the Imports for the year 1929 would appear to indicate that there is room for considerable extension in the breeding of live-stock in Ceylon.

During that year Ceylon imported live animals and animal products for food purposes, to the value of Rs. 7,257,338. This figure is the value as given at the Customs and is in most cases very much lower than the figure at which these products are actually sold to the consumer. Our annual bill, therefore, is a considerable one.

It is my purpose to-day to consider, very briefly, the reasons why Ceylon is not self-supporting in respect of these products, and to indicate if possible means by which this drain on the country's resources may be lessened.

I propose to deal with each class of live-stock separately.

SHEEP AND GOATS

The Customs returns for 1929 show that goats to the number of 100,298 valued at Rs. 2,005,960, and live sheep to the number of 21,846 valued at Rs. 436,960 were imported from India and Aden. The majority of these are slaughtered for food purposes at Colombo, the remainder being sent to outstation towns, chiefly Kandy, Nuwara Eliya, Ratnapura, Negombo, and Galle.

It is an extraordinary situation that Ceylon has to obtain her supplies of such hardy and easily reared animals from places as far distant as Bangalore and Aden. The animals which are imported are not of very superior quality; indeed the bulk of them are little if at all superior to the local goat. Further they deteriorate during the long and tedious journey to Colombo, so much so, that many of them arrive diseased and die shortly after arrival.

In addition to the live animals, Frozen Mutton to the value of Rs. 235,683 and Tinned Mutton to the value of Rs. 8,817 were imported. That is a total bill for sheep and goats of nearly Rs. 3,000,000.

There would appear to be no reason why the greater part of this large sum of money should not remain in the country. Goats, and to a lesser extent sheep, are bred in parts of the Island such as the Jaffna Peninsula and Batticaloa District. Very little attention or care is bestowed on the animals by their owners. In

Jaffna they are kept chiefly because goat manure is of value for the cultivation of tobacco, however, sufficient mutton to satisfy the local demand is produced in that area.

Colombo alone consumes approximately 100,000 head of goats per annum almost all of which are imported from India. During a temporary cessation of importation last year Colombo had to depend on Ceylon bred animals. Considerable difficulty was experienced in obtaining sufficient numbers. It was noted however that while the carcases of the Ceylon goats were on the whole smaller than those of the Indian goats, yet they were much freer from disease, and the mutton was of better quality.

Goats, and more especially sheep, do not thrive on damp heavy soil. Breeding them in the wet zone is not therefore likely to prove successful, but goat breeding would appear to be an industry admirably suited to the dry zone districts.

Goats do not live on grass. They will eat grass but thrive best on the leaves of shrubs. Areas of scrub jungle on light sandy soil provide favourable conditions. Such areas are to be found in the dry zone and goat breeding should provide a very valuable adjunct to village agriculture in such areas.

Obstacles to the development of such an industry are the following:

1. *Lack of marketing facilities.*—The best market in the Island is Colombo. Unfortunately the Colombo butchers all appear to have business connections with the Indian importers, and as as result of the credit system are not free, even if they wished, to obtain their supplies from any other source. The Indian goats are landed in Colombo almost, one might say, on the butcher's doorstep, whereas to obtain Ceylon goats it would be necessary for the butcher to send his agents out into the villages to buy the animals, collect them together at some point on the railway and despatch them to Colombo. To remedy this state of affairs a co-operative society would appear to offer the best solution. Such a society could have its own mutton stalls in Colombo and in the larger outstation towns at which only Ceylon mutton would be sold.

The stalls would be supplied by regular consignments sent through the society by its members in such districts as for instance Mannar, Mullaittivu, or Jaffna. The society could also obtain and make available to members stud goats of improved type and popularize castration of the young male kids, an operation which greatly improves the quality and quantity of the mutton, and which is seldom done in Ceylon.

2. *Losses from wild animals such as leopard and jackal.*—In jungle districts these levy toll on the flocks, but the losses can be reduced by herding the goats during the day and kraaling them

at night. The herding is work suitable for boys and kraaling at night-time enables the very valuable manure to be collected for use as fertiliser.

3. *Lack of good stock for breeding.*—This could be remedied by some of the wealthier landowners importing goats from India or elsewhere, breeding them under suitable conditions, and distributing the males for use in the villages.

4. *Diseases.*—The chief diseases from which goats suffer are pleuro-pneumonia, worm parasites, and anthrax. These three diseases are most prevalent when goats are overcrowded or kept on wet swampy land. They can be reduced to a minimum by avoiding overcrowding and wet land.

I hope I have said sufficient about sheep and goats to show that there is a possibility of developing this branch of stock breeding in Ceylon, especially in the drier districts, with consequent benefit to the village population.

Coconut planters might try the experiment of running a flock of sheep on their estates.

A word must be said concerning the great value of goat milk as a food for infants and invalids. Cow milk is scarce and expensive throughout Ceylon. A goat can be kept under conditions which would make it impossible to keep a cow and the practice can be recommended to people who find difficulty in obtaining supplies of good cow milk at a reasonable price.

POULTRY

During 1929 Ceylon imported Frozen Poultry and Game to the value of Rs. 137,545, live poultry and game to the value of Rs. 316,351, and eggs to the number of over 15 million, valued at the Customs, at the very conservative figure of Rs. 502,301. That is, our bill for poultry and eggs reaches a total of Rs. 956,197, practically a million rupees. One has no hesitation in saying that it is possible to keep the whole of this sum of money in the country.

Poultry thrive in Ceylon, indeed Ceylon is the home of one of the progenitors of all the breeds of domestic fowls. The eggs and live poultry imported come largely from South India and a large proportion of the eggs are duck eggs. Surely South India is not more fortunate than Ceylon in respect of climatic and other conditions favourable for poultry breeding. As far as duck breeding is concerned one could not wish for more favourable conditions than are to be found throughout the wet zone.

A variety of reasons appear to be responsible for the small numbers of poultry kept in Ceylon.

In the first place the bulk of the Sinhalese population are not interested, on account of religious prejudices, against the taking of life. Apart from this, there is the lack of marketing

facilities. The best market is to be found in the towns, but the villager has no means of reaching this market except through the medium of itinerant dealers, and the prices obtained are not sufficient to stimulate interest. A further reason is the very small size of the eggs and the lack of flesh on the chickens. Subsidiary reasons are losses from jackals, crows, snakes, hawks, and mongoose; losses from disease which on occasion may be heavy; and losses by theft.

As regards measures for improving these conditions, very little development of this industry can be looked for among the strictly Buddhist population on account of religious prejudices and efforts should, therefore, be concentrated in the non-Buddhist sections.

Improvement of marketing facilities and of the breed of poultry should give scope for co-operative societies.

Local societies would act as centres for the collection of eggs and chickens and would forward them, by bus, for sale to larger central societies situated in Colombo and other towns. These central societies could have their own stalls for the sale of the produce. The local societies could also be used for the distribution of improved stock.

Improvement of stock could best be obtained by crossing of the local breed with imported stock. It would not be advisable to encourage villagers to replace the indigenous breed with pure bred birds of imported stock nor indeed would it be practicable. Very marked improvement in size and number of eggs and in rapidity of growth of chickens can be obtained by crossing hens of the local breed with cockerels of improved breeds.

In this connection a method which has been tried and proved a success in some of the African colonies such as Kenya and the Gold Coast would appear to have much to recommend it in Ceylon.

Instead of distributing cockerels here and there throughout the country, a method which is bound to be slow in producing results as the influence of the improved breed is swamped by the great preponderance of the indigenous stock, attention has been concentrated on selected villages. The interests of the headmen and villagers having been aroused by visits and lectures an offer is made to them of cockerels of improved breed in exchange for their own cock birds, on condition that all, or at least a very large proportion of their own cock birds, are surrendered. Any of the improved cockerels which may die are replaced free. This work has generally been done through the Veterinary Department who maintain small poultry farms for the breeding of the cockerels and for the sale of settings of eggs at a very low figure. The cockerels surrendered by the villagers are sold on the market and

help to reduce the cost of production of the improved cockerels. Another advantage of this method is that indiscriminate crossing with a number of breeds is avoided. The issuing authority first decides on the breed to be used and obtains birds of the very best quality. Only one breed is kept and continued issues of the same breed results in uniformity and continued improvement among the village fowls.

I would recommend this method to the Ceylon Poultry Club. They would be performing a very useful service and furnish a very valuable demonstration if they select some village and supply the people with good cockerels in exchange for their present birds. Should the experiment prove a success neighbouring villages would become interested. A further advantage of this method is that after a few years of issuing good cockerels the type of fowl in the village would become improved to such an extent as to be suitable for distribution to neighbouring villages.

As regards losses from disease there are certain points which must be observed if these are to be reduced to a minimum. Avoid overcrowding and land which has been used for breeding poultry for a number of years, that is, get the birds away from the immediate vicinity of the bungalow; avoid indiscriminate purchases of new stock from unknown sources, for example, the itinerant hawker; and prevent birds straying outside your own premises.

Losses from vermin such as crows, snakes, etc., are heaviest when the birds are young and can be reduced by confining the young chicks to runs during the first few weeks of their life. Thefts of eggs can be avoided by the use of properly constructed and locked laying boxes.

In the coconut districts there are thousands of acres of land suitable for poultry rearing. In these days when prices of coconut produce have fallen so badly planters might turn their attention to poultry as a side-line. To any planter who contemplates the experiment I would give the following advice:

1. Start in a small way and extend as experience is gained.
2. Be sure your stock is obtained from a reliable source.
3. Provide movable houses which can be securely locked to prevent theft of birds and eggs.
4. Avoid the immediate vicinity of the estate bungalow —get the birds out on to clean land.
5. Do not keep weakly or old birds. Very few hens over three years of age will pay for their keep.

Owners of tracts of wet swampy land should try the experiment of keeping a flock of ducks or geese. Given wide range over such lands these birds will find the bulk of their food.

During the first 2 or 3 weeks of their lives they require protection from direct sunshine or from heavy rains. After that they are very hardy and suffer little from disease.

There is always a demand for well-grown young turkeys at Christmas time. Turkeys require plenty of free range. They cannot thrive on contaminated soil. Attempts to keep too many or to confine them in small runs are sure to meet with failure. If turkeys are kept they should be kept separate from other poultry. It is not advisable to mix them. The adult turkey is responsible for spreading gape-worms which may cause heavy loss in young chickens.

One could say much more on the subject of poultry, but I am afraid time will not permit.

I would urge on any person who has suitable land the advisability of keeping a good class of fowl. Even if only enough are kept to make the household independent of outside supplies something will have been done to reduce Ceylon's bill for imported fowls and eggs; a bill of such dimensions as to constitute a reproach to the country.

CATTLE

The position in Ceylon at present may be stated shortly as follows: With the exception of frozen, tinned, and salted meat to the value of Rs. 357,858 the meat supply for the past 18 months has been furnished by the local cattle and buffaloes. That is, the bulk of the meat consumed is locally produced. The imported meat is more or less a luxury article and of a quality which it is quite unlikely could ever be produced in Ceylon. The local supply appears to be ample to meet the demand and prices are not high, unfortunately, it is of poor quality.

Dairy produce is imported in large amounts, the figures for 1929 are as follows:

Frozen Butter	Rs.	451,664
Tinned Butter	,,	269,555
Ghee	,,	261,950
Preserved Milk	,,	1,631,360
Skimmed Milk ...	,,	14,499
Fresh Frozen Milk ...	,,	1,375
Cheese	,,	155,955
	Rs.	2,786,358

We are therefore practically self-supporting in so far as meat is concerned, but import considerable quantities of dairy produce.

The poor quality of our local cattle is frequently deplored, and from time to time suggestions are made for their improvement. The suggestions, most frequently made, are the issue of

stud bulls of improved types, and the provision of pasture lands. It is my opinion that no lasting improvement can be expected by distributing stud bulls of larger and better breeds. In the first place the cost would be prohibitive. We have a million head of cattle and half a million head of buffaloes in the country. If we take a quarter of these as cows of breeding age and allow one stud bull for every 40 cows it will be seen that 10,000 stud bulls would be required. A few hundred bulls scattered over the country can have no permanent effect on the breed. The introduced blood is swamped by the enormous preponderance of local blood. In the second place, the reason of the inferior quality of our cattle is, that for the conditions under which they are kept, they are the only type of cattle which can exist. So long as present conditions of cattle keeping in Ceylon remain as they are, then, so long will the local breed be the only breed suitable. It has become adapted by natural selection and survival of the fittest operating over a long period of time, and any attempt to replace it by a superior type without radical alteration in conditions is not likely to be a success.

The average cattle owner keeps cattle primarily in order that he may have one or two bulls suitable for carting purposes. His cart bulls are the best specimens he owns and, when working, are carefully attended and generally get some artificial food, *e.g.*, poonac and straw. The cows and young stock are unprofitable, the quantity of milk produced by the cows being so small as to make them scarcely worth the trouble of milking. The result is that the owner is not prepared to incur any expense in feeding or caring for them; he expects his cows and young stock to find their own living on such waste lands, roadsides, or fallow paddy fields as may be available in the neighbourhood. Under such conditions breeding is not controlled in any way by the owner. As I have said, the best bulls are used for carting, leaving the undeveloped young bulls, bulls rejected for carting purposes as undersized, and old bulls no longer fit for carting work to act as stud bulls. The inevitable consequence is that the herd increases in numbers and deteriorates in quality. As a rule no attempt is made to reduce the numbers by disposal of old animals, and undersized or otherwise unsuitable animals. The obvious avenue for disposal of such animals is by sale to the butcher, but for religious and sentimental reasons this avenue is availed of only with the greatest reluctance.

In most districts cattle are not used to any great extent for cultivation of paddy land this being chiefly done by buffaloes. Apart from carting, the only use the cattle are put to is for manuring, as on coconut estates.

Buffaloes are used for cultivation of paddy lands and, in some parts, the cows are milked for the purpose of making curd.

Cultivation of paddy fields takes place only during a short period of the year, for the remainder of the year the buffaloes bring in no return to their owners and are neglected and turned loose to live and breed as best they may.

The underlying reason for the poor quality of Ceylon cattle and buffaloes is therefore economic.

The measures necessary for improving the cattle are fairly easy to enumerate but they will all cost money, and it is not so easy to see how the villager is to get a return for money so expended. The prohibition of import of cattle from India has done something to stimulate a demand for cattle for slaughter purposes and to provide a remunerative outlet for surplus stock. Unfortunately the consumption of meat in Ceylon per head of population is not large and the number of cattle absorbed in this way is not very great.

Improvement of the cattle would result if the following conditions which I have listed in order of their importance could be brought about:

1. A decrease in the number by elimination of old, decrepit, undersized and otherwise unprofitable stock.
2. The improvement of lands used for grazing by fencing and clearing of scrub jungle.
3. The growing and storing of fodder crops for use during periods of drought.
4. Better feeding of young calves. This is important. At present if a villager has a cow which is a better milker than the remainder of the herd he is likely to take practically all of the milk for his own use leaving too little for the calf, with the result that the calves of the better milking cows are starved and many die, while the calves of the poorer milker live.
5. Early castration of all young bulls of inferior quality leaving only the most promising bulls for breeding.
6. Reservation of the very best of these bulls for breeding instead of using them in the cart.

I would emphasize that if any attempts are to be made to improve cattle by crossing with imported breeds then an essential preliminary is an increase in the food supply. The necessity of concentrating such effort is also important. A small district should be selected and all the available stud bulls of the improved breed issued to this one district. If such a policy be combined with an intensive castration campaign there would be some prospect of general improvement of the cattle of the district. Such a district might ultimately become a source of supply of stud bulls for other more backward districts.

So far my remarks have been confined to cattle of the local breeds as kept by villagers—dairy cattle are kept under different circumstances.

As the Customs figures show the demand for milk and milk products is not met by the local supply and large quantities are imported.

Dairying on a commercial scale is not profitable if the local breed is used. The Ceylon dairies are therefore stocked with cattle of imported breeds either Scind cows from India or cows of various European breeds from England and Australia, or crosses between these types.

High-yielding cows of European breeds are successfully bred in some of the up-country districts. They are largely owned by Tamil coolies on tea estates. They are seldom allowed to graze being kept in small sheds, and fed on Paspalum grass cut from the roadsides and ravines supplemented with gingelly poonac. Such cows find a ready sale in Colombo. The prices fetched varying between Rs. 300 and Rs. 450 according to the milk yield. Milk in such districts is plentiful and cheap. In Colombo and other towns it is scarce and very expensive. The reason it is scarce and dear is that no means have been developed for transporting milk over any considerable distance without deterioration. The towns therefore depend for their supply on dairies situated either actually in the towns or in the immediate vicinity. Milk from town dairies must inevitably be dear if the dairyman is to secure a profit as expenses are heavy. In the first place rents are high, all cows have to be purchased as there are no facilities for rearing young stock, all foodstuffs including even grass have to be purchased, labour is expensive, and losses are heavy as cows crowded together in small dairies are more liable to disease.

As I have said high-yielding cows are bred on the estates at high elevations and, doubtless, many more would be bred if there was a profitable outlet for the milk produced. Such an outlet could be furnished by the establishment of creameries in these districts for collecting, pasteurising, and despatching milk to Colombo. The transport of milk over considerable distances, even in the Tropics, is practicable by the use of efficient pasteurising machinery and refrigerating vans on the railway. To my mind it is along these lines that Ceylon must look for an increased supply of milk at a reasonable cost.

It may be asked why should not dairies be developed in the low-country in close proximity to Colombo so obviating the necessity of transport over long distances. Such dairies are in existence on a small scale but they labour under certain disadvantages. In the first place, the supply of nutritious grass is difficult and, in the second place, on account of the prevalence of

ticks and ticks borne diseases such as piroplasmosis and anaplasmosis, cows of the high-yielding European breeds are difficult to breed.

For dairies situated in the low-country the most suitable breed would appear to be first crosses between Scind cows and a bull of such imported breeds of high milk yielding capabilities as the Ayrshire or Friesian. An essential for such dairies is a campaign against ticks. The most economical as well as the most effective method of combating these pests is by means of a dipping bath.

There is one other feature of the Customs returns which is rather surprising in view of the general apathy concerning live-stock in Ceylon. I refer to the sum of Rs. 15,000,000 for imported artificial manure. I believe, I am correct in stating that farmyard manure is equal, if not superior, to any artificial manure so far as crops grown in Ceylon are concerned.

An increased development of the live-stock industry would help to reduce this very large bill for imported manures.

DISCUSSION

Mr. H. L. De Mel expressed his gratitude to Mr. Crawford for the practical suggestions in his excellent paper. He felt sure that when some of his young friends established themselves as gentlemen farmers throughout the island, they would have more of those little farms which would supply pasteurised milk and capons for the City's consumption. He suggested that the Director of Agriculture might, quite apart from publishing the paper in *The Tropical Agriculturist,* issue it in the form of a pamphlet to be distributed throughout the country. As regards the rearing of cattle and sheep on estates, this was already very largely done, for animal husbandry was an important adjunct to coconut cultivation. He appreciated the emphasis laid on the difficulty of improving village cattle. He himself found that the best way towards surmounting this was to do as he had done and dispose of some of his younger bulls from his cattle farm in Kurunegala to the villagers in the neighbourhood. In the matter of poultry farming a great deal was done by the Christian population along the Negombo-Chilaw road and it did one's heart good to see crates full of chickens carried on tops of motor-buses into Colombo, for disposal there. He would like, however, to see young men of the student type taking to dairy farming. The ideal would be for groups of these farmers to combine in co-operative effort with a motor-van and one or two stud bulls common to the group. This method of co-operative endeavour was practised very largely in Germany and Denmark and proved very successful.

Mudaliyar N. Wickremaratne enquired whether the statistics mentioned in the paper were a correct census of cattle in the Island, and if so, of the million head of cattle how many were employed for purely agricultural purposes.

Mr. Crawford replied that no distinction had been made in the figures mentioned by him which he had listed as supplied in the headman's returns.

Mr. Sturgess said that if figures for any particular district were wanted he would be glad to supply them, and in response to a request by Mudaliyar Wickremaratne gave the following figures for the Kurunegala district : Neat cattle, 202,850, of which 20,925 were milch cows ; buffaloes 31,859 of which 17,606 were milch cattle.

Mudaliyar Wickremaratne recalled that when rinderpest broke out in the south in 1910 thousands of head of buffaloes used for ploughing perished and the villagers were reduced to using neat cattle for ploughing, despite sentimental prejudices. He suggested that it might be useful if statistics were kept separately of agricultural, draught, and dairy cattle.

Mr. Reginald Fernando stated that in the North-Western Province all the neat cattle reared were only used for breeding cart bulls and for grazing on the roadsides.

Mr. H. A. Webb asked what steps were advisable to reduce the enormous numbers of inferior stock in the Island.

Mr. R. C. Proctor remarked on the inhuman practice of tethering cattle to coconut palms in all weathers in the North-Western Province. The poor animals were sometimes strangled and he desired to know if statistics could not be obtained of the number of cattle used for this purpose so that the S.P.C.A. might take the matter up.

Sir H. Marcus Fernando remarked that Mr. Crawford's remarks were in conformity with the views he had stated the day before in connexion with animal husbandry in coconut cultivation. They were very thankful to Mr. Crawford for his excellent paper, which covered a very wide area of ground. He would like to offer some remarks on the paper as he had some experience of the subject. In regard to sheep his little experience was very unfortunate. Through the office of Mr. Stockdale he had imported some sheep from Mauritius, but they died from pneumonia as soon as they reached his estate. With goats, on the other hand, he had considerable experience for a number of years. On the suggestion of his son, and through the Department of Agriculture he introduced into the low-country, goats of the Jamnapuri breed from the United Provinces of India. Unfortunately, the animals which in the first instance were not fit to be exported, arrived here in a very weak state of health. He placed them on an estate where there was plenty of food and grazing, but which was also very damp, with the result that he lost a number of the animals. He next introduced the goats into a drier area, but here his efforts were unsuccessful, because the goats suffered a great deal from eating the flowers of *Tephrosia candida*. He now had a number of half-bred animals, which were better acclimatised to the district. On the whole, goat raising had not been a success possibly due to climatic conditions. He thought that they would do better on sandy soils, as was proved by the experience of Mr. W. M. Rajapakse of Goluwapokuna Estate, who raised the animals quite successfully and had a good market for them in Negombo.

He had no experience of poultry, but his observations led him to think that people would not take to poultry as a utility concern with confidence owing to the prevalence of poultry diseases.

He felt that cattle breeding, both for transport and dairy purposes could be made quite successful on coconut estates, if due attention was paid to it, and if planters would not consider that the only purpose that cattle served on coconut estates was to provide manure There were great opportunities in the wet zone of raising a far superior breed of cattle than that which now existed. It required understanding and skill, which however, were easily acquired and he suggested that the work could be entrusted to conductors who had been given a training in dealing with cattle. Some one had remarked the day before that stall-fed cattle would never pay. To controvert this, there was the statement of Mr. Crawford that hundreds of kanganies on up-country estates practically raised all their cattle by stall-feeding. Unfortunately, the animals were given no exercise, with the result that they suffered in the low-country. They

were not at all hardy, could not stand the sun or walk any distance. They were also subject to tick fever which was a very serious disease among milch cows. When the animals were taken to the low-country young, though they sometimes developed a mild form of tick fever, they gradually became acclimatised for the rest of their lives. As regards rearing a high class of dairy cattle, the speaker said that he had attempted to cross Freisian imported stud bulls with Scind cows from up-country, the reason being that Indian cows which were a very poor breed when compared to the British breeds evolved for milk purposes, but if crossed with Ceylon cattle of Freisian descent produced a high class of milk animals. The Freisian breed was well fitted to tropical conditions. It had a sleek coat, and could stand the tropical sun well. The males were excellent for transport whether half-bred or imported. Since 1921, the speaker said, he had only dealt with Freisian stud bulls, and now had two generations. Many difficulties had to be encountered, the chief of these being rinderpest.

Mr. Crawford himself had trouble with the disease at the Government Dairy, but he hoped with the institution of the new quarantine station rinderpest would disappear from Ceylon. With regard to red water and tick fever, if the animals were born in the low-country, there was no trouble at all. Speaking of pasturage, the speaker said that on coconut estates, there was room for improvement of the pasturage. With regard to his own estate, however two samples of pasture which he had sent to Mr. Joachim were found to be equal to the highest class of pasturage in Ceylon, and he believed that it was quite possible to maintain a high class of cattle on coconut estates with improved pasturage.

Sir Marcus expressed his disappointment with other members of the meeting who had cattle on their own estates and had not participated in the discussion and given them the benefit of their experience. It was no use saying they kept cattle only for manure purposes. There seemed to be some misunderstanding about cattle in the Kurunegalle district, the prevalent idea being that all the cattle belonged to estates. He himself knew in the 'nineties of 800 head of cattle being grazed around Arumpola estate, all of which belonged to villagers in the neighbourhood. There was another estate of 300 acres on which were grazed 350 buffaloes belonging to villagers.

A PLEA FOR PASTURES AND THEIR IMPROVEMENT

EMIL J. LIVERA, B. Sc. (Lond.) Dip. Agric. (Wye),
DIVISIONAL AGRICULTURAL OFFICER,
NORTH-WESTERN DIVISION

I must at the outset apologise for disagreeing with the Hon. Sir H. Marcus Fernando's view that the breeding of cattle by stall feeding is practicable and that this practice should be more generally adopted. In support of my view I quote Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen. In an Empire Marketing Board Publication (No. 18, 1929, p. 13, entitled "The Composition of Pastures") he says: "Modern improved breeds of cattle with a rapid rate of growth have been evolved in districts with improved cultivated pastures. The improvement of the breed and the pastures have gone hand in hand and are closely connected. But in developing animal husbandry in new countries, sires of improved breeds have been imported to 'grade up' native cattle without any 'grading up' of the pastures. The common result has been that as the 'grading up' process proceeds, mortality increases. The natural herbage which is able to support in health slower growing native cattle, which have evolved on this herbage, is too poor in constructive material to support more rapidly growing animals. The equilibrium between the grazing animal and the herbage is upset, and the resulting mortality and sterility are really part of a natural process tending to the elimination of a type whose rate of growth and of production is greater than the herbage can support." If further evidence of the truth of Dr. Orr's pronouncement is needed one has only to look through the history of the development of German agriculture during the latter half of the last century. With the increase of population and its movement towards the large towns arable farming and stock raising were intensified and this meant an increase of nutritive substances for both plants and animals. This marked the beginning and rapid development of artificial fertilisers for plants and artificial nourishment by way of concentrated feeds very rich in protein and for the most part imported. At first all seemed well with this method but later when German agriculture passed through critical times, this type of feeding became too dear and rendered stock raising uneconomic and unremunerative. It was, however, not till the outbreak of the great war that Germany

realised that for stock feeding the most practical, most natural, and most economic method consisted in intensifying the forage production on the grassland, the pastures, and in the rotation of crops.

I must, nevertheless, admit that even where a high level of forage production has been reached, a considerable use of concentrated foods will still be lucrative, because maximum yields can only be obtained by this means combined with the use of good forage. Have we in Ceylon come to that stage of stock development and pasture improvement when we have to call in the aid of expensive concentrates, like gingelly, cotton, or coconut poonac which are naturally lacking in mineral matter and which have in the process of their manufacture lost their vitamins? Should we not get into stride with other parts of the Empire and the rest of the agricultural world and devote more attention to pastures which Mr. Amery, the late Secretary of State for the Colonies, in the preface to "A record of concerted endeavour to foster the better exploitation of the Empire's Grasslands" says is a subject pre-eminently worthy of intensive research on an Empire basis.

Before coming to the question of the improvement of pastures let us convince ourselves that pastures are the most natural, most practical, and most economic raw material for the formation of milk, meat, mutton, hide and other products of live-stock. In Ceylon, except with capitalist breeders, it is the only raw material because the poor villager cannot afford anything else. It is universally admitted that good pasture is the best feeding stuff for herbivora. The reason is apparent when we compare the composition of good pasture with that of other food-stuffs.

The following table (from the Empire Marketing Board's Publication 18, p. 8.) shows the fairly close correspondence in the mineral and protein content of good pasture to those in cow milk:

	CaO	P_2O_5	Na_2O	K_2O	Cl	Protein
Cow's milk	2·38	3·43	0·81	3·21	1·4	52·00
Good pasture	3·64	2·75	0·94	11·54	3·5	65·00
Maize	0·03	1·83	0·13	1·36	0·001	29·00
Decorticated cotton cake	1·22	11·26	0·24	8·05	0·11	164·50

The resemblance shown in this table is undoubtedly a very important factor in determining the high nutritive value of good pasture not merely in promoting growth but chiefly in maintaining health in stock. What better evidence of the practicability of pastures for the production of meat is needed than the fattening qualities of the pastures of the Tamankaduwa area of the Anuradhapura district? Its cheapness is also sufficiently obvious.

Sufficient, I trust, has been said to convince even the most sceptical of the value of pastures to the agricultural and economic welfare of the Island. Let us now enquire whether Ceylon pastures are in need of improvement. Can we conceive a tea or coconut plantation which is regularly cropped but receiving no attention whatever by way of cultivation or manuring ? What attention have we given our pastures which are cropped, *i.e.*, grazed in and out of season, and the productivity of which is taxed beyond their normal. Can we fail to recognise that there is a slow invisible flow of soil fertility with every herd of live-stock that is grazed on our pastures without any compensating return to the soil ? Depletion is inevitable and is hastened by drought. As depletion proceeds on an impoverished soil the vegetation tends to disappear and the pasture responds less readily to whatever rainfall there is and any existing vegetation is literally eaten out. A barren soil denuded of pasture is the inevitable result. In all parts of Ceylon, pastures in various stages of deterioration can be seen by the most casual observer.

How then can our pastures be improved ? Only a very careful study of our pastures can provide a definite answer to this question and this answer I am not in a position to give. I may, however, indicate in very broad terms such methods of improvement to which some of the pastures that have come under my notice are sure to respond.

Drainage.—A well-aerated healthy soil is just as necessary to grassland as it is to arable land. Water-logged pastures are invariably overrun with useless weeds, especially the *Cyperaceae*, and *Eriocanloneae*. The vegetation of any land is a very good guide as to whether drainage is needed or not. The need for drainage is obvious in lands which were once under rice but are now for some reason or other abandoned. Nothing but prompt and thorough drainage can save those lands from reverting to useless waste lands. On well-drained land the grass has a better chance of growing and establishing itself in a competition with such weeds as thrive on water-logged soils.

Irrigation.—In earlier centuries irrigation of grasslands was carried out on a large scale in European countries and this practice has been revived and is on the increase. Spray irrigation of pastures has proved very beneficial in advanced countries. Everywhere it has been found that irrigation of pastures has increased their yield. The phosphorus, potassium and magnesium content of pasture was found to rise with irrigation while the calcium content fell. Where flooding is not practicable for reasons of an insufficient water supply a system of channels, while serving the dual purpose of watering the animals and the pastures, will also help to keep the land from getting water-logged in wet weather.

Water meadows in Ceylon are not known to me but their possibilities are evident alongside the banks of rivers and streams which are subjected to occasional flooding. Could not the occasional flooding of the Mahaweli Ganga which then overflows its banks in the Tamankaduwa district partly account for the productivity of its pastures ?

Clearing.—The need for this is very evident in paddy lands which have been abandoned sufficiently long ago and which have now reverted to scrub. Nothing short of a thorough freeing of this land of the scrub together with draining is needed for its improvement.

Land which has been reclaimed from varying stages of deterioration by one or more of the above methods, will then need further attention and fencing should be one of the first steps towards the maintenance of the pastures in good condition and towards our goal, their increased exploitation. Judicious grazing is just as important as correct manuring and grazing cannot be controlled without fences. The position of the fence must be determined by the convenience of working the land and the uniformity of the grazing. The size of the enclosure has to be determined by such conditions as climate, soil, and extent of the grazing herd.

Grasslands will certainly need manuring. What manures should be applied investigation only can reveal. Manuring should, however, be preceded by mechanical treatment. Some pastures have been so regularly grazed that every possibility of adventitious growth has been reduced to a minimum and only a mat of roots is left. No amount of manures can be expected to break through such a mat and reach the soil. Rejuvenation of that type of soil is necessary by breaking up the mat. Such coarse grasses as *Chrysopogon aciculatus*, *Setaria glauca*, *Aristidia setacea*, which are due either to insufficient grazing or other unexplained reasons act as a serious check on good herbage plants. They have to be removed, often by drastic burning. The fire should pass quickly over the herbage so that any of the finer plants which may be struggling for an existence may not be unduly injured. Burning should be followed by harrowing before manures are applied.

Chief among the factors affecting the composition and, therefore, the utility of pastures, are the several species of plants with their seasonal variation and degree of growth under varying conditions of climate and soil. The introduction of desirable grasses and legumes as *Axonopus compressus*, *Desmodium* spp., *Paspalum conjugatum*, *Alyssicarpus*, *Pannicum fluitans*, *P. colonum*, *P. pilicatum*, *Stenotaphrum complanatum*, *Cynodon dactylon*, *Setaria sulcata*, may be first steps towards improvement after such preliminaries as draining, fencing, and burning where necessary.

Qualities of grasses suited for grazing are either those with a creeping habit or those with the capacity of producing numerous small leaf shoots as well as the large flowering shoots. These plants must also be able to maintain themselves under the influence of the grazing animals. *Ipomea*, *Commelinia* and *Mikania*, have been found to be useful species for grazing although they are not grasses.

Shade trees are a very necessary adjunct to pasture lands as they protect both the cattle and the grass in the very hot weather which is aggravated by a period of drought. Such trees as *Poinciana regia* and *Leucaena glauca* affording a light feathery shade are more suitable than dense shade. Such trees as *Mimusops hexandra*, *Acacia* spp., the pods of seeds of which are readily eaten, should be planted up.

Manuring can now follow. It is not possible for me to say with certainty what manures should be applied but I may mention such elements of plant food which are indispensable.

Liming will undoubtedly be helpful although as a general rule grassland will stand a higher degree of acidity than arable crops. Liming influences the quality of pasture. Joachim (*The Tropical Agriculturist*, LXVIII, 1927 pp. 269-271) has amply proved the poverty of Ceylon *cultivated* pasture grasses in minerals especially. We can from that gauge the quality of uncultivated pastures. Crawford (*ibid* p. 279.), while admitting that, "Manuring the soil with phosphatic manures and calcium is obviously the most direct method of attack" says "it has the drawback of being expensive. It is more suited to mixed farming than to grazing." He favours "Supplementing the grazing by foodstuffs known to be rich in the deficient minerals, especially as regards calcium content." German experience cited above has proved that better grazing is not only more practical but also more economical. Before deciding the question of cost and feasibility one must take into consideration the train of subsidiary effects liming has both on the soil and on the pasture. We must not lose sight of the fact that grazing does not mean merely grass but anything which is palatable, non-poisonous, and of nutritive value. Liming encourages the growth of leguminous plants of the type of *Desmodiums*, etc., which cattle eat readily and which are rich in calcium. It has also been proved that one can take more liberties with the grazing on limed soils without permanent damage to the pasture. Lime also serves as a preparation for such other manures as phosphates by promoting the more rapid disappearance of coarse and badly grazed herbage.

Phosphatic manures are by far the most important for grazing land although there are some lands which do not respond easily to phosphates. Here too as in the case of the manuring of other crops considerations of soil and climate should determine whether phosphates should be applied and, if so, in what form. The phosphorus content of herbage has been shown to fall during drought. In South Australia the indication is that soil moisture can be conserved by enriching the soil. This result, if confirmed, will be of great economic importance to pasture lands in dry districts. It may here be mentioned that in Ceylon water seems to be the limiting factor to the productivity of pastures. Phosphates act on grassland by inducing tillering and the development of lateral and fibrous roots, cause a bottom growth of legumes which act as a wet blanket keeping the temperature down, keeps grass from growing too sappy, and enriches pastures.

On poor grazing land potash by itself does not seem to be effective and it should only be used either in conjunction or on land previously treated with phosphate. Kainit is usually applied because the common salt in these fertilisers makes coarse herbage more palatable to stock which pull it off and help in cleaning up rough patches.

The nitrogenous manures on grassland is either on an intensive or extensive scale and as no definite results are available under Ceylon conditions no useful purpose will be served in this paper by any comparison of, or reference to, either of the methods. It is a subject which had better be left for experience to decide. Nitrogenous manures help to maintain the "freshness" of a pasture over a longer period and the herbage known as "May" grass can be produced in England as late as July or even August by their use. Under extensive grazing systems farmyard manure should be both available and the best source of nitrogen. It should not, however, be left to be about as it induces rank growth and coarseness of the herbage.

All attempts at the improvement and maintenance of grassland by mechanical and manurial treatment will be of no avail if the grazing is not controlled. Experience alone can teach us at what stage of the growth of a pasture the maximum yield can be obtained by grazing and the extent to which the pasture could be safely grazed down before it is rested. Rotational or intermittent grazing of pastures has proved to be more economic and profitable in England. The ideal method is to tether the animal—a practice regularly followed on permanent pastures over considerable areas and on large farms in the south of Sweden. Its possibilities are greater in Ceylon because of the more favourable conditions for growth of plants throughout the greater part of the year. Intensity of grazing will have to be reduced with the

advent of dry weather and care will be needed that the pasture is grazed to a nicety so that neither too rank a growth is left to be parched up by a drought nor too little left for recovery when better weather sets in. The art of grassland management involves the manipulation of a number of factors.

One may be inclined to deride all the suggestions for improvement of pastures put forward in this paper on the score of cost. What the actual cost will be, it is not possible for me to say but communal labour and a levy on each head of cattle that is grazed ought to be able to meet the expenditure a great way. If only on an experimental scale, it is a trial worth making when one remembers that it is an attempt to not only assist paddy cultivation which everyone looks upon as a national industry but also to improve our live-stock of which just now we have every reason to be ashamed. Besides the methods of improvement mentioned in this paper there are several other points on which research is needed, *e.g.*, the question of mowing *versus* grazing in districts where growth is more luxuriant. Research alone can show the adaptability and applicability in local conditions of methods, the results of which so far achieved in other countries, have proved remunerative.

COTTON CULTIVATION IN THE HAMBANTOTA DISTRICT

W. R. C. PAUL, M. A., M. Sc., D. I. C., F. L. S.,
DIP. AGRIC. (CANTAB.)
DIVISIONAL AGRICULTURAL OFFICER,
SOUTHERN DIVISION

COTTON is now an established crop under cultivation in the Hambantota district. It is chiefly grown in chenas and provides the peasant population of the district with an opportunity of supplementing their meagre incomes. Over two thousand acres are at present under cultivation with seed annually supplied by the Department of Agriculture.

The earliest attempt to grow cotton in the Hambantota district was made in 1912 when the Ceylon Agricultural Society inaugurated trials with Cambodia cotton. The intervention of the War, which followed, caused an interruption, and, in 1921, the Department of Agriculture undertook to carry out experiments in cotton cultivation. These were begun on some plots at Ambalantota and Kiula and are now being continued on the four experiment stations which have in due course been established in the district. The success of the early trials and the attempts of the peasants to grow cotton in small plots caused the organisation of a peasant scheme which rapidly expanded in a few years' time. The subsequent depression in cotton prices, the unseasonal weather for the cultivation of the crop experienced later, during several years, and the increasing damage caused by the trespass of stray cattle and wild animals have done much to discourage the efforts of the grower and retard the progress which is being made. Cotton is, nevertheless, one of the few crops in the Hambantota district which provides the villager with a source of income in the form of money and unless prices drop heavily much further it is not likely to be abandoned.

The Ceylon Spinning and Weaving Mills, Colombo, who purchase nearly all the cotton produced in Ceylon have done much to encourage the development of cotton cultivation in the Island. They have regularly offered prizes in the form of gold medals to winners of the cotton competitions which are held each year and though they virtually enjoy a monopoly in the purchase of cotton they have, it must be admitted, considered the interests as well of the growers.

EXPERIMENTAL WORK

The experiments carried out by the Department of Agriculture were begun in 1921 on some plots at Ambalantota and Kiula with a number of varieties representing types from America, the West Indies, India, and Egypt. The yields obtained ranging from 3 cwt. to 6 cwt. per acre with the different varieties were considered satisfactory, the two outstanding being Durango, an American Upland, received from the United States Department of Agriculture, and Cambodia, a variety grown largely in the Madras Presidency. The following year the trials were continued on the Cotton Experiment Station opened at Ambalantota with a further strain No. 15 of Cambodia and an American Upland from South African seed. The Durango showed a marked increase in yield giving about 9 cwt. per acre. In the subsequent trials, other South African varieties were also grown together with fresh importations of the previously grown varieties. In general, the yields of most varieties showed a gradual decline. Certain varieties, *e.g.*, Sea Island, Sakellarides, Watts Long Staple were discarded mainly because they were considered too fine for the requirements of the Mills in Colombo to whom all the cotton grown in the Island was sent. Other varieties were also discarded because of their low yields and for the 1926-27 season only two varieties were retained—Durango and Cambodia. The manurial trials which were also conducted during several seasons gave no conclusive results.

The Ambalantota Experiment Station is representative of a soil of the type of a heavy loam where drainage conditions and weed growth present great difficulties. In 1926 it was decided to open two new stations for cotton rotation work at Bataata and Middeniya, which would serve the coastal and inland areas of the Hambantota district under lighter soil conditions, the soil of these two stations being of a more sandy nature.

The 1926-27 trials were limited to Cambodia and Durango varieties, but weather conditions were unfavourable and heavy flower and boll shedding occurred. No conclusive results could be drawn even from the spacing trials. In the following season three new early maturing strains of Cambodia were imported from Coimbatore and tested against the local Cambodia strain 15 which was the result of mass selections carried out since 1922. At Middeniya and Bataata Stations, Durango varieties were also grown but the best yields were only obtained from two of the Early Maturing types at Middeniya, where just over 4 cwt. per acre were recorded. Spacing and manurial trials were again ineffective, the season being unfavourable. The results of the 1928-29 trials showed that the local Cambodia was superior to the Early Maturing types and that the Durango strains were so susceptible to attack by Jassids that their continuance was not

desirable. Accordingly these were discarded but the two new varieties Zululand Hybrid and Improved Bancroft which were imported in 1928 by the Ceylon Motor Transit Company and yielded satisfactorily at all stations in comparison with other varieties were retained along with the local Cambodia strain 15.

In 1929 a new cotton station was opened at Tissamaharama. It was found that the best village cotton in the whole district was being produced from Magam Pattu and that the rainfall and soil conditions appeared more suitable for cotton cultivation in this area than elsewhere in the district. A station was needed as a main breeding station for cotton where supplies of seed for the needs of the whole district could be made. Ten acres have so far been opened but it is proposed to extend the area gradually each year until eventually a sufficient area has been obtained for the maintenance of a supply of pure-line seed for distribution to the growers in the district.

For the 1929-30 season fresh seed of Cambodia strain 15 was imported as it was desired to test the yields of seed freshly imported each year against those of local seed of the same strain. These were carried out at Ambalantota, Bataata and Middeniya Stations and the results are tabulated hereunder:

Table I

	Ambalantota	Bataata	Middeniya
Cambodia strain 15 local selection	$3\frac{3}{4}$	$6\frac{3}{4}$	2 cwt. per acre
Cambodia strain 15 Imported 1929	2	$2\frac{3}{4}$	1 ,, ,, ,,

At Tissa Station the imported Cambodia strain 15 was grown alone and a yield of nearly 6 cwt. per acre was obtained.

Four new types were also imported from India last year viz: Karunganni C 7 and A 10, Kumpta, and Uppam, and were grown at all stations, but the yields were negligible, flowering taking place late in the season and the bolls when formed being insignificant in size.

It is therefore proposed to concentrate on Cambodia strain 15 which has proved to be the most suitable type of cotton so far for the district whilst also retaining for further tests Improved Bancroft and Zululand Hybrid varieties. Selection work on these varieties will be continued, while other varieties from India which are likely to prove superior to the local types will also be tested from time to time.

THE PEASANT SCHEME

As a result of the success of the 1921-22 trials carried out by the Department of Agriculture on the plots at Ambalantota and Kiula, seed of American Upland varieties was issued to villagers for planting cotton in small plots during the next season. About 300 acres were cultivated and the crop was bought from them by

the Department and sold to the Ceylon Spinning and Weaving Mills in Colombo. It was then decided to organise a peasant growing scheme by which seed would be supplied to the growers by the Department who would also undertake to purchase the crop from them. Chena permits for planting cotton on one acre were granted either separately or along with the usual two-acre kurakkan chenas. Seed of Durango was distributed for the 1923-24 season but as this was insufficient it was supplemented by an Upland variety imported from South Africa. Altogether about 600 acres were brought under cultivation that season and about 700 cwt. of cotton produced. The Ceylon Spinning and Weaving Mills, Colombo, undertook to purchase all seed cotton produced in the district at a definite price per cwt. delivered at Colombo and the Department acted as the buying agents. Various purchasing centres in the district were arranged and the growers brought their cotton to these centres, where it was weighed and paid for immediately from an advance met by the Mills. At each centre a certain price was fixed which covered the cost of transport of the cotton to Colombo and the working expenses of the purchase. It was also seen that the cotton which was brought to the centres for sale was well sorted and graded. For the 1923-24 season, nearly Rs. 12,000-00 were paid to the villagers who grew cotton and for the last season's crop when there was a depression in the cotton market and only Rs. 16-00 was offered by the Mills for Cambodia cotton in contrast to Rs. 20-00 in 1923, the sum of Rs. 30,580-60 were paid to the growers. The subjoined table gives the figures of the yields, averages, the price offered by the Mills and the actual payments to the cultivators:

Table II

Season	Yield Cwt.	Acreage	Price quoted by the Mills per cwt. f.o.r., Colombo		Payments to the cultivators
			Rs. Cts.		Rs. Cts.
1922-23	15½	300	35 00		
			20 00	Cambodia	
1923-24	710	600	25 00	Upland	11,957 41
			25 00	Cambodia	
1924-25	1,225	—	25 00	,,	23,815 58
1925-26	2,700	1,000	21 50	,,	45,513 59
1926-27	1,907¾	1,193	15 00	,,	
			(subsidy of Rs. 5·50)		31,592 35
1927-28	1,911¾	1,591	17 00		
			(subsidy of Rs. 1·70)		30,541 19
1928-29	3,588¼	2,800	18 50		32,167 45
1929-30	2,200	2,297	16 00		30,580 60

The purchasing centres which were originally scattered in various areas are now confined to the four cotton experiment stations where stores are in existence and also at Liyangastota

where a cotton store has been erected. Only one purchase is now carried out during the first week of May and during this week the whole agricultural staff in the Hambantota district is engaged on this work. Much praise is due to these officers during this period which involves long and continuous hours of work. Each village or group of villages is allotted a certain day on which the cotton will be purchased at the nearest centre and every endeavour is made to complete the purchase of cotton on the same day that has been fixed for a particular group of villages, in order that the growers who come from long distances may not have to wait unduly long at the centres before their cotton is bought. The bags brought in by the villagers are emptied and stacked in the stores of the Department after which re-bagging is done with standard bags provided by the Mills. The cotton is then transported by lorry to Matara and thence by rail to Colombo where delivery is taken by the Mills.

The scheme provides the villagers of the Hambantota district with an annual crop which though in comparison with other crops of the district takes the longest period to grow yet provides them with a ready source of income. The present low prices of cotton are however causing a certain amount of discouragement to the growers but to those who realise the value of a money crop and who understand good methods of cultivation, cotton has come to stay in the district. It is doubted that unless prices drop considerably further cotton cultivation will ever be abandoned in the Hambantota District.

The difficulties and hardships which the chena grower has to contend with in the cultivation of not only cotton but other crops in the district are considerable. Many villagers have complained to me of the difficulties which they experience in obtaining permits and accuse the local headmen of imposing conditions which they are unable to fulfil in many cases. The villager who has been fortunate enough to secure a permit commences the work of felling and burning the chena land issued to him during August and September. He erects a brush wood fence around and after planting is complete in October he remains every night in his observation hut on his chena guarding his crops from the ravages of wild animals and especially elephants. The lot of the chena grower during this period is most trying. Not only has he to contend against the destruction caused by wild animals but he has also to face the damage caused by the trespass of cattle into

his chena. Numerous cotton chenas have been destroyed by stray cattle which roam about the country in large numbers. It is particularly unfortunate that these are generally useless neat cattle owned by the local headmen and the most influential villagers and are allowed to roam about freely seeking what food they can obtain.

Elephants are also responsible for a large share of damage to cotton chenas and it is not an uncommon sight to find whole chenas completely destroyed by these herds in a single night.

Attention should also be called to the prevalence of malaria which is most virulent just at the period when the cotton plants need special attention. Weeding is often neglected and as a result a considerable drop in the yields of cotton is thus effected. The control of these factors—damage by elephants, trespass of stray cattle, and the prevalence of malaria would do much to improve the yields of cotton and the conditions of the cultivator.

CULTIVATION METHODS

The aims of the Department have been to include cotton in a rotation scheme which would eventually replace the present chena system. For this purpose the use of implemental tillage is necessary if a larger area than the present maximum of 3 acres allowed a chena cultivator is to be taken by a family. Trials are at present being conducted with the object of cultivating cotton and other rotation crops in the dry zone under the most economical methods and with the employment of the minimum number of implements.

Ploughing is the first tillage operation preparatory to the sowing of a crop, and in the past trials were carried out with the use of Cletrac tractor and disc plough, and by cattle with Ransome's Victory and Ceres ploughs. The last named has been the most satisfactory and economical, but future trials will be carried out with the use of lighter and cheaper ploughs, *e.g.*, the Meston. Two ploughings are done, one being crosswise, carried out after harvesting is over of the last crop. When the ploughing has been completed the use of a disc-harrow has been found very effective in breaking down the clods, but as this implement is somewhat costly, and prohibitive for the use of the small grower it will not be employed in further trials which will be confined to the simpler Indian implements such as the Guntaka. This is a harrow type of implement which has given satisfactory

results so far at Ambalantota. The checking of weed growth and improvement of the tilth of the soil can be maintained by the use of a zig-zag or chain harrow but the substitution of a light Guntaka will be considered in future trials. Sowing is carried out in October with the first showers of the north-east monsoon rains and has hitherto been performed by hand. The use of a bamboo seed drill is to be tested during the next season. The most suitable planting distance has been found to be 2 ft. by 4 ft. between the rows. Soon after sowing when the plants are a few inches high weeding should be carried out. This has been done with the use of a Planet Junior Cultivator, but the employment of the Guntaka has also given satisfactory results. Several weedings are necessary as the growth of cotton is greatly checked by the presence of weeds. A final weeding by hand is desirable when the plants have grown too large for the use of implements. Flowering takes place during the latter part of December and early January and picking may commence from about the middle of February extending until the end of April. After the crop is picked it should be carefully sunned and graded.

The following figures give the present costs of cultivating cotton per acre, estimated only on the actual cost of labour employed:

Ploughing	Rs. 5·00	2 ploughings
Harrowing	,, ·36	Zig-zag harrow or the Guntaka harrow
Sowing	,, 2·50	Hand sowing
Weeding	,, 5·00	Use of Planet Junior Cultivator on 3 occasions with an earthing up by hand and a final weeding by hand
Harvesting	,, 7·50	
Sunning and Grading	,, 2·00	
	Rs. 22·36 per acre	

Cost of implements

Ceres plough	Rs. 35·00
Zig-zag harrow	,, 75·00
Guntaka	,, 10·00

Estimated crop of 6 cwt. per acre.

Future work, however, will be confined to the possibilities of reducing these costs further by the employment of cheaper and simpler implements which will be within the reach of the small cultivator.

The cultivation of cotton is contemplated along the lines of a rotation system in which cereal, leguminous and money crops will be included, but it is not proposed in this paper to discuss the rotation schemes under trial.

CONCLUSION

In conclusion, it may be said that the progress of cotton cultivation in the Hambantota district has been impeded by several factors, but as cotton has proved to be one of the few crops in which marketing difficulties do not arise it is not likely to be abandoned. The depression in cotton prices during the last few years has had a discouraging effect on the growers, who have also to contend against such other difficulties as damage to chenas by stray cattle and wild animals and the prevalence of malaria. The average yields of seed cotton in chenas are between 2 and $2\frac{1}{2}$ cwt. per acre. Neglect to plant cotton in definite rows and to carry out regular weeding is common, and much higher yields could be obtained if attention was only paid to these two conditions. The experimental work of the Department has been confined mainly to the selection of suitable varieties and strains for the district. The results of the trials carried out since 1921 have indicated the general superiority of Cambodia cotton, an Indian variety, a local selection of strain No. 15 of this variety have given the best yields so far. Further selection work will be carried out in the future while comparative trials with other varieties will also be continued.

Weather conditions play a most important *rôle* in cotton cultivation. Periods of heavy rainfall experienced either during the early or later stages in the growth of this crop result in much damage and poor yields. During certain years, *e.g.*, the 1926-27 and 1929-30 seasons when abnormal rain was experienced in the district there was a considerable effect on the crop of the Experiment Stations.

With improvements in methods of cultivation and the use of the most suitable strains for the district which form part of the future programme of the experimental work in cotton carried out by this Department it is hoped that cotton cultivation will occupy a foremost place in the Hambantota District.

RAINFALL RECORDS

	1921-22	1922-23	1923-24	1924-25	1925-26	1926—27			1927—28			1928—29			1929—30		
	A	A	A	A	A	A	B	M	A	B	M	A	B	M	A	B	M
September	—	0·23	9·35	4·95	0·52	2·48	2·23	1·38	4·31	4·75	5·68	0·31	0·29	0·35	5·47	7·08	4·52
October	5·15	5·77	6·38	2·70	7·61	6·13	2·23	1·38	1·14	1·88	6·81	4·60	7·31	4·91	0·60	3·04	3·70
November	2·43	4·61	8·41	3·50	6·46	8·16	5·31	6·47	5·75	11·08	5·46	11·04	10·41	15·08	23·23	17·97	13·54
December	3·24	1·29	7·36	2·27	11·77	2·15	2·05	6·32	4·58	4·32	6·96	5·36	2·54	7·11	9·16	6·87	6·75
January	0·64	4·20	3·15	6·14	8·62	4·81	5·38	4·07	3·03	2·22	2·70	0·40	1·02	2·29	2·49	0.86	1·46
February	2·20	2·71	1·17	0·90	—	2·50	5·14	3·40	0·98	1·03	2·37	0·35	2·33	0·96	2·32	1·70	10·86
March	2·56	0·85	9·08	6·86	0·81	12·15	11·96	8·83	1·50	4·48	5·05	5·14	5·98	2·40	5·01	6·41	5·50

A—Ambalantota

B—Bataata

M—Middeniya

DISCUSSION

GATE-MUDALIYAR M. S. RAMALINGAM enquired whether the Agricultural Department had tried Delft for growing cotton. Some years ago Mr. B. Horsburgh, then Government Agent of the Northern Province, collected some samples of soil and forwarded them to the Agricultural Department for report but since then the speaker had heard no more about it. In the opinion of the speaker the soil in certain parts of Delft was quite suitable for cotton growing. If the Department could detail an officer to be sent round the country to examine soils suitable for cotton cultivation in the various parts of Ceylon, the speaker was sure it would be of immense benefit to the villagers as well as to the country as a whole.

The Director of Agriculture (DR. W. YOUNGMAN) said that the question of cotton growing in the island had not been overlooked. They were even now looking into the question of growing cotton in the island mentioned. The difficulty in connection with the matter was the rainfall in the island of Delft. The cultivation of cotton required 8 inches of rain for four months; in Egypt the equivalent of 32 inches of rain during the growth period was found to be ideal. In India in tracts when they had 45 inches of rain during the whole period they got yields as high as 800 to 1,000 pounds of seed cotton per acre. He was not quite sure that the rainfall in the island of Delft was not more a limiting factor than soil conditions. In connection with cotton growing, certainly the most important factor was the rainfall. "The question of cotton growing in the island has not been, nor will it be overlooked," concluded DR. YOUNGMAN.

REV. FR. L. WICKREMESINGHE said that a great handicap to the encouragement of cultivation in the villages were the headmen who claimed their share of the villagers' output. They should also, he thought, introduce into the village schools hand-looms for spinning and weaving, which would absorb a great deal of cotton. He suggested the grant of land to the villagers for cotton cultivation and the introduction, by the Agricultural Department, of ginning mills.

MR. DARRELL PEIRIS said that cotton growing had been taken up in right earnest in the village of Bomiriya by a Women's Institute and spinning with the charka which cost no more than Rs. 10 locally. He wished to know whether experiments in cotten growing had been conducted in the Western Province. They had large acres available for the purpose in the Western Province and he asked whether it was suitable.

MR. W. R. C. PAUL said that, as the Director had observed the chief factor was the rainfall which should however not be too heavy. In that respect the Western Province was not generally suitable. A dry climate was also necessary.

THE DIRECTOR OF AGRICULTURE said that as regards ginning cotton in Ceylon, the question had received the attention of the Department and he expected a ginning instrument shortly, if it had not already arrived. With regard to a hand-ginning machine costing Rs. 10 locally, he said that in India village carpenters made them for Rs. 3 each, and he saw no reason why the Ceylon carpenter should not display his ingenuity by putting it on the market at a cheaper rate.

THE CHAIRMAN (SIR SOLOMON DIAS BANDARANAIKE) said that Mr. Paul had read a very interesting paper. Cotton cultivation in Ceylon, he thought, was going to be an economic industry in the future. He understood that the villagers were taking readily to the cultivation of cotton in their small holdings. There was a move now to teach the village youth the art of spinning and weaving. He hoped it would prove a success. It was a source of great pleasure to him that a son of one of their greatest medical men in Ceylon had taken such a great interest in agriculture and he hoped before long that he would be as distinguished in the agricultural science as his father was in his own profession.

AGRICULTURAL INSTRUCTION IN RURAL SCHOOLS

J. C. DRIEBERG, DIP. AGRIC. (POONA)
DEPARTMENT OF AGRICULTURE, CEYLON

AT the present time we have schools for trades such as carpentry, weaving and pottery, yet, by an extraordinary anomaly, no institution for training village lads to follow the vocation to which they were born, and which they would follow except for the fact that they forsake the countryside in search of other pursuits in the towns. But since the education which they have received so far has not seriously directed their attention to agriculture as their calling in life, and no training has been given to fit them for this work, it is nothing to wonder at that they feel themselves unfitted for the cultivation of the land, that they possess a disinclination for work of this type, and that they are impelled with a desire to seek other spheres of activity, which in some instances, are fraught with serious consequences. Certain steps have been taken in the past to meet the necessity of imparting an agricultural bias to rural education, but these have been meagre in proportion to the needs of the country, and to judge by results, their effects have scarcely been felt. Village agriculture has not improved vastly; nor is there any clamour for land by the educated youth of the rural areas.

The object of this paper is to review the action that has been taken in the past and to urge that the organization of definite agricultural training in connection with rural education, on the lines suggested, be taken in hand, in order that general education may be linked up, through this medium, with the economic and social welfare of the country.

The beginning of what may appropriately be termed the Rural Science Movement lay in the School Gardens Scheme which was established in 1901, under the Department of Education. But it is an important fact that this scheme was organized and developed by an agricultural officer, and that assistants who were appointed at a later stage were themselves men with practical experience in agriculture.

In 1906, however, the School Gardens Branch was transferred to the Department of the Botanic Gardens which in 1912 developed into the Department of Agriculture.

The first great impetus to Agricultural Education was given by His Excellency Sir Henry McCallum, who, besides taking a personal interest in the matter, appointed a Committee to report

upon a scheme of agricultural training for Ceylon. The amended despatch which received the sanction of the Secretary of State contained, among others, the following recommendations:

(1) that the new policy should be gradually introduced, beginning with reforms in the village schools as distinct from purely agricultural schools;

(2) that the proposed Central School of Agriculture at Peradeniya should be postponed until a future date; and

(3) that the best and most economical plan of bringing agricultural education to the doors of the population would be by gradually developing the village schools and establishing less ambitious provincial schools of which 4 were to be established within three years.

The object of these schools was to give an agricultural training to teachers who later would be placed in charge of village schools in important centres which are selected for giving agricultural instruction of a more advanced type than can be given in ordinary village schools.

This recommendation was made so far back as 20 years. While schools of agriculture at which teachers can receive a training have been established, the idea of developing special village schools has not materialized, and the means whereby this recommendation may be given effect to is suggested in this paper. In terms of a recommendation in His Excellency's despatch of 1911 referred to, the preparation of suitable text-books was taken in hand, and a Junior Agricultural Reader prepared by the Superintendent of School Gardens was issued in 1913, and followed later by a Senior Agricultural Reader.

After the formation of the Department of Agriculture in 1912, the idea of the four provincial schools gave place to a central school at Peradeniya which was opened in 1916, contrary to the original proposal, and instead of its being an institution whose primary purpose was the training of teachers, it was run on different lines, and the class for teachers failed to receive the fullest measure of attention that was intended.

In the first year, 6 teachers were sent by the Department of Education and in subsequent years the number was doubled. These teachers receive a year's training, and up to now 145 teachers have passed through the school at Peradeniya.

With the opening of the Farm School at Jaffna in 1926, similar classes for teachers were inaugurated, and so far 27 teachers from the Tamil schools have received instruction in agriculture.

During all this time the School Gardens Scheme developed apace under a whole-time staff consisting of the Superintendent and 4 Inspectors who were specially trained for this work, and in

1917 there were no less than 333 registered gardens attached to rural schools throughout the Island.

School gardens were designed originally for providing material for nature study, and a point of some importance that I would draw attention to is that the educative value of the garden was not wholly overlooked by the staff of the Agricultural Department inasmuch as the Inspectors systematically conducted nature study lessons in the class room and actively assisted teachers in their own work of instruction.

With the decentralization of the work of the Agricultural Department which commenced in 1920, and the simultaneous retirement of the Superintendent of School Gardens, this work passed into the hands of the Divisional Officers and Agricultural Instructors.

In 1923 a more definite attempt was made to give an agricultural bias to the instruction imparted in the rural schools through the introduction of a syllabus in Nature Study and Elementary Agriculture to be used in all the standards and this was prepared by the Inspector of School Gardens at the request of the Department of Education.

Economic conditions in Ceylon became somewhat unsettled in 1924, and in his Administration Report for that year, it is worthy of note, the Director of Education drew attention to the value of indirect vocational training as a valuable equipment for life, as it would open the eyes of pupils to the vast possibilities in industry and agriculture; furthermore, that while there was room for directly vocational schools, he did not think that they could be easily grafted on to an ordinary elementary or secondary school, since the greatest defect of that method was that it dealt with only a few of the pupils, whilst the vast majority were uninfluenced by that training.

It is also interesting to learn from the same report that there were ten selected vernacular high schools which worked on a special curriculum with special teachers, to function as models, and that these were full of promise.

There is also an observation by an inspector of schools which has an important bearing on the suggestion offered in this paper, namely, "It is pleasing to record that several teachers have succeeded in interesting their children in the utilitarian aspect of school gardening, and this is an encouraging sign in view of unemployment."

This view was further emphasised by the Director of Education with whom I was privileged to have an interview in 1926, when he stated that he wished to see school gardening, and particularly the cultivation of paddy by the pupils of village schools, worked on a commercial basis. So that we have the economic aspect of school work accepted in principle.

At this time the Director of Agriculture formulated proposals for the further expansion of the work of his Department, and these were submitted for discussion by a Committee of the Board of Agriculture, which urged the necessity of providing for courses of instruction in the vernacular at the agricultural school proposed for Galle; and recommended that in the case of the school for Wariyapola, a trial should be made for 5 years of affording agricultural training in the vernacular on the apprentice system and if successful, that this should be extended to the other divisions.

In the next year an Agricultural Reader of wider scope than the previous ones was issued, and with a view to further the decision that the curriculumu of the elementary schools should be modified and a distinct rural bias imparted to the instruction given at such schools, the Department of Agriculture prepared the Handbook on Rural Science, in 1928, and followed it with a Handbook on School Gardening.

The School Gardens Scheme, in the meantime has been steadily progressing and at the end of last year there was a total of 948 registered school gardens of which 75 were attached to Girls' Schools, 125 to Assisted Schools; and 748 to Government Vernacular Boys' and Mixed Schools.

In view of opinions that have forcibly been expressed of late, and in order to meet the economic needs of the country as evidenced by conditions prevailing at present, it is necessary to organize means of providing provocational agricultural training. I do not think that technical or trade schools will meet the case, as there does not appear to be a demand for these at present; but the demand for these important institutions can be created if a preliminary training is given, as suggested, in conjunction with the general education at school. Indeed, it is essential that agricultural training should form a part of the education imparted in rural schools. It is then only that the importance of such training and instruction can be appreciated to the full. But I do not advocate the wholesale adoption of this idea in all schools, as this will not prove a workable scheme. In the same way as a special curriculum has been adopted at the selected High schools, so should agricultural training be organized at selected schools in typical areas. A beginning may be made with 5 or 10 such schools, but in course of time there should be at least 100 central village agricultural schools distributed throughout the Island. There is no difficulty in securing the necessary teachers for these schools, as we now have 172 teachers who have received a training at Farm Schools, and the best from among them can be selected.

The essential features of such a scheme should be that the training should be (1) compulsory, (2) of practical nature, (3) on a sufficiently large scale, and (4) on definitely economic lines. The area should not be less than 5 acres which should be cultivated not only with a view to showing a return but also to afford a training in the practice of agriculture rather than instruction of the didactic type. This work should be confined to the pupils in their last year at school, and the syllabus in Rural Science for Standard VIII should be dealt with in connection with the training on the school farm. In the earlier stages, however, the pupils will receive elementary knowledge through nature study and gardening.

There is no necessity of an excessive outlay of funds on these schools. Besides the land required, they should be provided with fencing, a means of irrigation, and an adequate supply of tools; but as in the case of the carpentry and weaving schools which repay the cost of materials supplied so may be the value of the implements be repaid within a specified period; and if worked properly these schools should be self supporting.

I would urge, however, that this farm should be worked on an economic basis, for which purpose the pupils should form themselves into a co-operative society. The training in methods of business which they will receive according to such a scheme should be of the utmost benefit to them in their future work.

In putting this scheme into operation we shall be carrying out one of the recommendations of the Unemployment Committee of 1927 to the effect that it was by organizing technical assistance and by providing for education with a utilitarian bias that the greatest assistance could be rendered at that juncture and further that it was important that the steps already begun in regard to a change in the form of education should be pushed on rapidly.

But apart from the purely economic aspect of this subject there is at the present time a very pressing need on the social side of rural life, and this has been brought to our notice of late by at least one who can speak with authority on such matters.

His Excellency speaking at the prize-giving last afternoon expressed the hope that teachers who received a training at the Farm School would convey the knowledge they gained there to the pupils of the rural schools to which they would return. There is no doubt that those who were keen have achieved a measure of success in this direction, but their efforts have not been productive of the results we hoped for. Nor could they be expected to do more than is possible within the curriculum of the general school.

It is therefore necessary that provision should be made for imparting not only more advanced knowledge of agriculture but, what is more important, a practical training in order to lead the pupils on to their right vocation.

It is gratifying to find that one of the terms of reference to the Commission which will be appointed to report on Paddy Cultivation is the question of agricultural education, and I trust that the suggestion offered in this paper will be found acceptable.

In conclusion, I venture to assert that the establishment of compulsory continuation classes in agriculture will materially help not only to preserve the self-respect of the village youth, but also to afford him an opportunity of developing into an economic asset to his country.

DISCUSSION

The Rev. J. S. Mather observed that the subject of rural instruction was one of the greatest importance to the general welfare of the people and the advancement of the Island. In the past there had been much talk and little action, but he hoped that the Conference would act as a stimulus to constructive effort. In the light of his experience as manager of a number of schools and of the experience gained in the work he was now doing in Colombo, he desired to offer a few suggestions. He stressed firstly, the necessity for much closer co-operation than now existed between the Departments of Education and Agriculture with particular reference to rural schools. Education in the village was a complete failure unless it was related to village life. The present curriculum in regard to rural schools was most ill-suited to village conditions. As to the means of best effecting the co-operation, he suggested that a Committee consisting of representatives of the two Departments might be elected to report on the ways and means of attaining the aim in view.

Mr. Mather then referred to the need for graded agricultural readers for use from the first standard, in order to strengthen a natural bias for an agricultural calling. He also suggested that a course in agriculture should be arranged in farm schools for teachers in training and that a system of practical agriculture might be introduced in village schools, whereby each pupil should have a plot of land to be cultivated by him. He finally appealed for official sympathy in the movement to turn back the tide of village youth into the towns and cities and suggested that this might take practical form in facilities for systematic and scientific agriculture in rural schools.

Mr. Darrel Peiris offered a few remarks on behalf of associations in Colombo engaged in rural re-construction and were also interested in the campaign for the prevention of crime inaugurated by Mr. Justice Akbar. Afternoon classes were being conducted for adults, who, in addition, were expected to work for two hours a day on a co-operative basis on land given by villagers, the fruits of their labours being shared equally by the owners of the land and the school. Mr. Peiris made an appeal for qualified instructors for these schools in order that the pupils might receive a proper grounding in agriculture which he and others who had acquired their knowledge on farms in France and England could only imperfectly impart. He felt that much could be done if the Agricultural Department joined hands with social workers. The speaker referred also to the work that was being done in the school started at Bomiriya for training in co-operative dairy-farming.

Mr. R. C. Proctor congratulated Mr. Drieberg on the excellence of his paper and dwelt at some length on agricultural instruction as a factor for stimulating local patriotism through which alone rural re-construction was possible.

The Rev. A. C. Houlder thought that the Director of Education might be asked to consider whether continuation classes could not be instituted. Previous speakers had suggested the need for a compulsory course in agriculture. The difficulty that straightaway presented itself to his mind was that a child could not be forced to remain in school after the age of 12. The problem could perhaps better be solved, the speaker suggested by extending facilities for general education in village schools and providing somethng in the way of an agricultural training on the lines suggested by Mr. Drieberg. He felt that, with the assistance of the Departments of Agriculture and Education and also the Co-operative Department, an organization could be brought about to work these joint classes in conjunction with the school authorities.

Mudaliyar N. Wickremaratne remarked that some good might still be derived from the present industrial depression if it would succeed in turning the villager back to his legitimate occupation on the land. He briefly traced the history of agricultural instruction and referred in this connection to the excellent work and example of Mr. C. Drieberg. From the little they knew of the present Director of Agriculture, he felt that they could rely on him to do a great deal in the way of rural re-construction. Speaking of the highly organised state of the major industries, Mr. Wickremaratne stressed the comparative neglect of the villager, who had only the Vel Vidane to turn to when in need of advice or assistance.

Mr. Jebaratnam offered the suggestion that Government might consider the question of granting land for agricultural training to mission schools.

TOBACCO CULTIVATION

WITH SPECIAL REFERENCE TO THE HIRIYALA HATH PATTU IN THE NORTH-WESTERN PROVINCE

HENRY L. DE MEL, C. B. E.

SCIENTISTS have described nearly forty species of *Nicotiana*, the majority being natives of the new world, though a few are to be met with in the Philippine Islands, New Caledonia, and Australia. Only two or three can be regarded as affording the commercial products, tobacco and snuff.

The commercial classification according to Dr. Watt is as follows:

(1) *Cigar-wrapper Tobaccos.*—Sumatra, Connecticut, Havana, and Connecticut Broad-leaf, etc.

(2) *Cigar-filler Tobaccos.*—Cuban, Zimmer's Spanish, Little Dutch, etc.

(3) *Pipe Tobaccos.*—North Carolina, Bright Yellow, Maryland Smoking, etc.

(4) *Plug Tobaccos.*—White Burley, Orinoco, Yellow Mammoth, Virginia Blue Pryor, White Stem, etc.

Tobacco smoking was unknown in Europe and Asia prior to the discovery of America in 1492. The Spaniards evidently commenced the cultivation of tobacco in San Dominigo in 1531 with African slave labour. Sir Francis Drake, Sir Walter Raleigh and others made tobacco smoking popular in England between 1570 and 1584 and about the same time cultivation was started in Virginia. In India the first direct reference to it centres around certain Portuguese missionaries at the court of the Great Moghul and it is believed that the Portuguese conveyed both the plant and the knowledge of its properties to India and China.

The earliest historical reference to tobacco grown in Ceylon is in 1610. Anthony Bertolacci in his "View of the Agricultural, Commercial and Financial Interests of Ceylon," published in 1817, gives an interesting account of the tobacco industry in Ceylon.

"The tobacco trade flourished chiefly in the Peninsula of Jaffnapatam, although considerable quantities were grown in other parts of the Island as well. The peculiar quality of the soil there gave it a particular flavour which made it suitable for chewing purposes. For a number of years the Raja of Travancore derived considerable sums by forming the exclusive privilege of selling that commodity in his own dominions to retailers at an

advanced price—a monopoly which the Dutch allowed to continue in return for contracts of pepper required to preserve cinnamon on their long voyage to Europe. Besides, the Travancore market, tobacco was also sold to Sumatra and at Point-de-Galle.

"On the advent of the English, the smuggling in of tobacco into Travancore (which proved highly lucrative) was vigorously suppressed by the Raja, and the existing monopoly maintained.

"The purchases were made in gold, in Porto-Novo pagodas, as neither Sumatra nor Travancore had commodities which could find a ready market in Jaffnapatam. The total amount of gold flowing into Jaffnapatam annualy was 120,000 to 140,000 Porto-Novo pagodas: but this gold was distributed throughout the Island in the purchase of grain and through the Coromandel Coast in the purchase of cloth.

"The supply required by the Raja's agents being the largest and as the cultivators were in the habit of receiving advances of money and were unable to effect a successful combination, they were compelled to accept very low terms which were hardly sufficient to keep the land in cultivation. The price fixed by the Travancore investment naturally governed the standard of the other two.

"This state of affairs attracted the notice of the Central Government, and Governors North and Maitland after vainly endeavouring to bring about a more equitable balance of trade finally imposed a duty of 36 rix-dollars per candy of 500 lb. British weight, *i.e.*, 60% of the value of that article at the place of exportation, the Sumatra consignment at 27 rix-dollars, and the Point-de-Galle consignment at 27 rix-dollars per candy.

"As a result of this measure a large additional revenue came into the coffers of Government; but the Raja was willing to raise the price in his own dominion and thus brought the burden of taxation to bear on the unfortunate merchants and cultivators. This occasioned severe distress and the monopoly continued to exist.

"The Government next proceded to combat the Raja's tactics by forming a counter-monopoly, but with doubtful success. It entered into a contract with the Raja of Travancore to furnish a certain amount of tobacco at a fixed rate, after having assumed the monopoly of all the export trade. The Government bought up all the raw tobacco on the market and undertook the responsibility of performing the processes of curing, etc., and of placing the finished product on the market. This had the effect of driving out of employment the traders and the merchants who were considered by some to be harmful to the industry. As a consequence there was much hardship which was aggravated by a

scarcity of grain in the years 1812 and 1813. The tobacco cultivators of Jaffnapatam had been in the habit of buying cloth and grain from the Coromandel Coast: when they were paid by Government in the Ceylon paper currency, this market was practically closed; and as the Government of Travancore was not punctual in its payment of Porto-Novo pagodas the cultivators were extremely hard pressed.

"Governor Brownrigg set himself immediately to remedy this evil, firstly by removing the Government monopoly on the Sumatra and the Point-de-Galle investments, secondly by an instant supply of bills and lastly by purchasing tobacco ready prepared for exportation."

The Customs returns of 1811 show the following entries:

> Value of total exports of tobacco—3,403 candies taken at 60 rds. per candy, exclusive of duties—204,210 rix-dollars.
>
> Details of goods exported coastways by Ceylon Merchants—610 Candies of Tobacco at 60 rds. per candy—36,600 rds.
>
> Duty paid: 16,471 rds. 3 fanams $2\frac{1}{2}$ pice.

The export trade of tobacco is now free of duty and the table at the end of the paper will be of interest—the value of our imports being four million rupees as against half-a-million of exports.

During the last decade the total tobacco area of India has been little over one million acres. The principal market for Bengal tobacco is Burma. In Southern India tobacco is grown and cured to suit the European market and several up-to-date factories now exist. In Ceylon we have one cigarette factory where imported leaf only is used, while in Matale, Teldeniya and Kandy, tobacco works have been established where cigars, pipe tobacco, etc., are manufactured.

In Ceylon the two species commonly grown are *Nicotiana tabacum* and *N. rustica*. Tobacco-growing in Ceylon for over two centuries has been chiefly for producing chewing tobacco and for the use of it with betel leaf, while the coarser cigars which are called Jaffna cheroots have been rolled for nearly a century for local use.

The best soil for tobacco is a light sandy loam rich in potash lime and humus, while the plant also flourishes on alluvial soils (on the banks of the Mahaweli Ganga and Deduru-oya).

A hot humid climate favours the growth and development of the special properties of the plant but a dry season is necessary to effect proper harvesting. Thus the season for planting in Jaffna is different from the seasons in the North-Western Province and on the banks of the Mahaweli Ganga and Dumbara.

A decade ago it was estimated that tobacco was grown in about 13,000 acres in Ceylon, over half of which was in the Northern Province. Although Jaffna was undoubtedly responsible for introducing and developing this old industry, a higher grade of tobacco is that grown in the Dumbara Valley of the Central Province which gradually spread to the Matale District, and these varieties spread to the North-Western Province, Batticaloa and Trincomalee districts. The total acreage now under cultivation is estimated at 15,000 acres.

The Dumbara tobacco was the best grade of Ceylon tobacco until the introduction of the White Burley in 1912 from America. This tobacco burns with a good white ash but is not sufficiently suitable in flavour to the European market. Dumbara Valley cigars were manufactured and freely sold in Colombo prior to the Great War.

The Jaffna type of tobacco is a very exhausting crop and manuring is essential. In Ceylon tobacco is grown generally under irrigation either from tanks or very often with the aid of well-sweeps. The whole object of the cultivator is a bulky crop and the labour put into growing of the crop is astonishing. In the Jaffna Peninsula besides cattle manure copious quantities of green leaves are used, the land ploughed up and a good tilth secured.

In the Chilaw district of the North-Western Province and in the Negombo district the soil of certain lands being suitable were utilised for this cultivation. The people of the districts of Chilaw, Negombo and Nainamadama have adapted a considerable acreage for raising annual crops of tobacco, sowing in hemp seed after the tobacco is taken and ploughing in the hemp leaf to replenish the soil.

It is singularly strange that no reference has been made in any of the Ceylon publications during the last thirty years to the very lucrative and progressive cultivation of tobacco in the Hiriyala Hath Pattu of the North-Western Province. Here a very extensive cultivation and trade have been carried on since the early 'seventies and today the annual crop in this Hath Pattu is estimated at eight to ten laks of rupees and covers 3,500 acres.

The discovery of a rich vein of plumbago in 1870 led the late Mr. Jacob De Mel to pioneer the plumbago industry in that Hath Pattu, and for the purpose of establishing some headquarters in the Kurunegalle town (which was 18 miles away from the mines and 12 miles from the then nearest railway station, Polgahawela) an old coffee estate was acquired in 1872. This land in 1874 was opened out in coconuts and most of the coffee which was then dying out was replaced by the planting of seed nuts transported from the well-known Pambala estate in Madampe. Some of the coconut planting labourers who had migrated from

Pamunugama and Marawila made some experimental plantations of tobacco in the spaces in between the coconut plants known as "coconut squares" with a degree of success; and when later on coconut plantations were opened on progressive lines on virgin lands, tobacco cultivation was soon established as a catch crop during the early years till the young plants grew up. Thus, gradually colonies of men who found the demand for tobacco increasing migrated from Chilaw and Negombo to the Hiriyala Hath Pattu, secured lands belonging to villagers when estates were not available and gradually established the regular growing of tobacco. Cattle are tethered at stake or within enclosures on plots of land which were cultivated in alternate years with tobacco; never have I seen much industry and hard work put in by the Sinhalese labourer as they do in these tobacco fields in the Hiriyala. For the last 25 years I have watched how these men dig as much as 18 inches deep right round the gala often two or three acres in extent removing every particle of root or foreign decaying matter which was not of manurial value, and then preparing the beds both for nurseries as well as for a field for this cultivation. Each of these galas must necessarily have a well and watering is done by hand; quite a large number of men take part in this watering of the plants both morning and evening in their early life. The land is manured between August and September, while in October, November and December the land and beds are prepared, and in six months the crop is ready for harvest. Right round the tobacco plot or gala, as it is called, is a fence where vegetables are freely grown; most of these creep up on the fence and give the cultivators some return till their tobacco farms are harvested and the produce realises cash. This cultivation is essentially the monopoly of the small farmer who themselves do all the work.

In about two months of planting the buds will appear and all side buds are nipped off, the operation being known as disbudding. Unless these are removed rapidly the vigorous growth of the plants and the formation of large healthy leaves are checked. The plants grow to a height of 3 to 4 feet and are topped to prevent flowering. When the leaves are ripe for cutting, sometimes plants are cut close to the ground and sometimes the leaves are cut day after day separately. After withering for some hours in the sun they are carried to a smokehouse or drying house (which is made of cadjan) and the tobacco leaves allowed to ferment. Those fermented and cured are graded. Sometimes the whole plantation is sold as a standing crop and the purchaser does the drying and fermenting. There is room for improvement in the methods of fermentation as now carried on. Wholesale dealers take the leaves away to all parts of Ceylon and distribute them among retailers.

Since 1912, however, the tobacco farmers from the Dumbara Valley who had spread to the Matale district have found a shortage of land for the growing of the better class tobacco known as cigar tobacco, which industry supplies the tobacco works in Kandy and Dumbara in turning out local cigars made with better class tobacco. These farmers have now migrated to the Hiriyala and each of them take on lease three or four acres of virgin land where after felling and burning all the stumps and roots of trees are eradicated. These farmers do not use cattle manure at all, a thinner or finer quality of tobacco leaf, richer in flavour and lighter brown in colour is produced. Thus in the Hiriyala Hath Pattu, there are two separate and distinct types of tobacco crops almost side by side, but with the essential difference that the one is grown on the old land with heavy cattle manure, and the other invariably grown on rich virgin soil. Of late the Government Agent of the North-Western Province has leased several acres to small farmers, along the banks of the oyas or in such suitable areas, on payment of an annual rent. The Hiriyala chewing tobacco forms the principal source of supply of the tobacco in all the provinces save the Northern and the Eastern, and indeed of late the cigar makers of Jaffna make large purchases of cigar tobacco which is grown in the Hiriyala Hath Pattu. Quite a large export has in recent years taken place from Kurunegala to Jaffna by railway for the cigar trade. Indeed the last four years the cultivation of tobacco in the Hiriyala Hath Pattu has given healthy and very remunerative employment to five or six thousand people in this area and unless overcome by exceptional rain falling at the wrong time or unexpected rain during the drying season this cultivation has afforded very fair remuneration, and in some cases exceptionally good profit where the land and available water is in abundance. It is, perhaps, interesting to note that the landowner gets 1-10th of the value of the standing crop which is estimated before the cutting and drying of the leaves. Any further profit made after cutting and drying the crop enures to the benefit of the purchaser of the crop, who may be the farmer himself or an expert dryer. Indeed this industry has been so well established that right through the nine months during which the tobacco farms work the local boutique-keeper, who advances the necessary rice and currystuffs to the farmers and their workmen on credit and only recovers his dues when the actual tobacco is dried and removed. There may be years in which a certain portion of the money is lost by failure of the crop. In recent years to the tobacco farmers of lands in Hiriyala belonging to me I have besides affording the usual facilities hired Abyssinian wells and a few lengths of piping to enable them to water their plants regularly with a smaller number of labourers. In a plot of six acres where cigar tobacco was planted 180,000

best quality leaf at about Rs. 15-00 per 1,000 were sold besides grades. The industrious man is always rewarded but he has to exercise great vigilance and keep off diseases and pests.

In July last I brought up this subject of tobacco cultivation before the Estate Products' Committee with a view to stimulating local interest and ascertaining whether a local cigarette industry could not be established to keep a part at least of the $3\frac{1}{2}$ million rupees now represented by the imported cigarettes. At present Ceylon exports to India, the Straits Settlements and the Maldives both tobacco and local cheroots.

At that meeting considerable interest was created in the cultivation of tobacco and I have, as a result, been asked to read a paper at the Agricultural Conference today. It was a matter of satisfaction to us to know that about 250 cultivators in Jaffna produced about 28,000 lb. of White Burley tobacco per annum which is exported to London. The reports on these qualities are satisfactory and the improvement of good quality tobacco is well worth pursuing. Just before the War, Messrs. Freudenberg & Co. carried on experiments with tobacco and when their stock of matured tobacco was sold in 1915, I purchased it and engaged Mr. Valabone, a Dutch tobacco expert who was then in Colombo, to roll cigars and a good and profitable business followed but we had not sufficient matured tobacco of that quality to continue the trade for more than two years. That tobacco was raised from seed imported from Java, Sumatra and the East Indies. It, however, remains a very useful avenue for young students who make science their study, to take up the question of planting tobacco under scientific supervision so that the objections raised to some of our cigar tobacco can be eliminated while burning qualities and flavour are retained. It has been reported that there was a high chlorine content in the White Burley grown in Jaffna and that it was possible to improve quality by taking greater care in the fermentation and also by preventing the tobacco being exposed to the sea air too long. I am not advocating the growing of tobacco for the European market as new countries are producing more each year, but I would, in view of the enormous amount of money spent by the public of Ceylon on cigars and cigarettes, that tobacco suitable to the European palate should be grown in Ceylon for local consumption so that we may not only keep capital from going out of the country but that we concentrate that capital in the country and create local wealth. The excessive chlorides in the Jaffna tobacco are probably obtained from the coral sub-soil being brought to the surface soil during the long periods of drought succeeding the fall of the heavy north-east monsoon in October-December. Besides, the well water used for irrigation may also be responsible for a certain proportion. There is also the possibility of improving the method

of irrigation without destroying the tilth when rainfall has been insufficient. One of the chief objects of cultivation is to give the plant a loose soil into which the young rootlets can easily and quickly penetrate. In transplanting the taproot has to be carefully taken care of. Likewise drainage must be arranged for otherwise the land will become water-logged, stunt the growth of the plants, and make the leaves turn yellow. The tobacco plant being a rapid grower requires a large amount of air in the soil for the benefit of the roots, the object being to produce fine broad leaves with a good flavour, a great deal of care and attention has, therefore, to be bestowed. This the average cultivator has learned by years of observation and experience, and it is for the better educated man to assist his observations with the necessary scientific assistance and co-operation, and I feel sure we shall be able to improve the growth of tobacco, its fermentation and preparation to secure a better value. The Travancore Government which was always one of our regular buyers, as indicated in the early part of this paper, now only permits 5,745 candies of Ceylon tobacco into Travancore of which 3,000 odd are taken in at Quilon and the balance at Allepi. In view of the growing economic conditions throughout the world which compel us to depend on one's own country for our food and necessaries, it seems a fairly hopeful sign that in this field of tobacco Ceylonese have every opportunity to acquire wealth.

We have a bulletin issued by the Department, No. 38 of 1918 on "Improved methods for growing tobacco in Jaffna" and a circular on "Diseases of tobacco in Dumbara" issued so far back as 1907; except the Kalutara snail no new pest or disease other than those already known have troubled this cultivation. In the district of Negombo during the last 15 years chewing tobacco is grown on old lands where cinnamon has been uprooted and replaced with coconuts. In such lands artificial fertilisers are freely used and are remunerative. It is more than a catch crop and may be repeated till the palms are about three years old.

I place before you samples of tobacco, pipe tobacco and manufactured tobacco, and would appeal to you to support this local industry whenever possible.

The export and import figures given below are self-explanatory.

TOBACCO EXPORTS

	1928			1929		
	Lb.	Rs.	cts.	Lb.	Rs.	cts.
Tobacco manufactured						
Beedies ...	575	402	00	481	2,041	00
Cigars ...	8,072	6,485	00	9,692	67,844	00
Cigarettes ...	1,235	3,940	00	2,193	17,569	00
Other ...	86	282	00	7	14	00
Total...	9,968	11,109	00	12,373	87,468	00
	Lb.	Rs.	cts.	Lb.	Rs.	cts.
Tobacco unmanufactured	1,643,441	390,512	00	3,193,567	572,202	00

TOBACCO IMPORTS

	1928			1929		
	Lb.	Rs.	cts.	Lb.	Rs.	cts.
Tobacco manufactured						
Beedies ...	76,895	382,655	00	70,571	330,970	00
Cigars ...	6,817	46,063	00	5,853	42,275	00
Cigarettes ...	574,277	3,306,274	00	571,185	3,462,010	00
Snuff ...	1,285	4,765	00	1,237	4,866	00
Other ...	13,375	58,798	00	14,321	63,985	00
Total...	672,649	3,798,555	00	663,167	3,904,106	00
	Lb.	Rs.	cts.	Lb.	Rs.	cts.
Tobacco unmanufactured	115,001	80,411	00	217,495	140,225	00

CLOSE OF CONFERENCE

BEFORE the conclusion of the Agricultural Conference at Peradeniya on Wednesday, the Chairman, Sir Solomon Dias Bandaranaike, invited the Director of Agriculture, Dr. W. Youngman, to offer a few closing remarks.

Dr. Youngman said that they had had during the Conference, the elements against them—a difficulty farmers always seemed to experience—but they had had at the same time the help of a great many friends. The weather that afternoon, he said, would interfere with their intended visit to the Experiment Station, where he understood there was one foot of water on the road. The weather also slightly curtailed their intended short tour of the Farm School activities the previous day.

PADDY COMMISSION

They had had, he repeated, a great many friends with them, who had helped them in a very valuable way, especially His Excellency the Governor who had presided over their deliberations during the first two days of the Conference. The interest of His Excellency in the agricultural problems of this Island was a very real one indeed, said Dr. Youngman. Their thanks are also due to the gentlemen who had acted as Chairmen and vice-Chairmen and to those who had read papers to them.

Referring to the opposition to a Paddy Commission, Dr. Youngman remarked that it was true as Mr. D. S. Senanayake pointed out that a Commission would only issue a report, "but," said Dr. Youngman, "the Board of Agriculture can see that action is taken." Sir Marcus had pointed out that if all the recommendations of the Commission were put into force the resources of the Colony would not be sufficient to meet them. It was no doubt necessary to concentrate upon a few facts at a time and that was another point which the Board could see to. They wanted early action of practical value to be the result of the appointment of a Commission and he had no doubt that the support of His Excellency, which had already been promised to them, would help to achieve that result so that they would be able to say that they had done something towards solving the problems of paddy.

RUBBER AND COCONUT DEPRESSION

Sir Solomon Dias Bandaranaike said: "His Excellency the Governor, in the course of his remarks yesterday, said that this Conference might appropriately send a message of sympathy to the Rubber and Coconut Industries, and I think it is our duty, before we disperse, to formally pass such a resolution. I, therefore, propose that

> "This Conference of the Board of Agriculture assembled at Peradeniya expresses its deep sympathy with those who are engaged in the Rubber and Coconut Industries and are faced with the difficult times at present existing."

Hon'ble Mr. E. R. Tambimuttu (vice-Chairman) said that he had great pleasure in seconding the resolution.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th NOVEMBER, 1930

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1930	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	1229	78	217	811	31	170
	Foot-and-mouth disease	262	...	252	10	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Colombo Municipality	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	447	...	434	12	...	1
	Anthrax	31	3	...	31	...	...
	Haemorrhagic Septicaemia	6	...	...	6	...	...
	Black Quarter	2	...	...	2	...	...
	Bovine Tuberculosis	1	...	...	1	...	...
	Rabies (Dogs)	11	...	...	...	...	11
Cattle Quarantine Station	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	...	..	...	...	...	...
	Anthrax (Sheep and Goats)	669 *	17	...	669	...	...
Central	Rinderpest	...	..	...	...	...	...
	Foot-and-mouth disease	650	...	648	2	...	...
	Anthrax (Sheep)	1	...	...	1	...	...
	Piroplasmosis	4	...	1	3	...	...
	Rabies (Dogs)	12	...	...	10	...	2
Southern	Rinderpest	322	27	76	246	...	...
	Foot-and-mouth disease	269	...	263	6	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	3	...	...	2	...	1
Northern	Rinderpest	4	...	3	1	...	...
	Foot-and-mouth disease	2975	...	2905	70	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	224	...	...	224	...	...
	Rabies (Dogs)	3	...	..	...	...	3
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	100	...	98	2	...	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	6795	962	392	5483	28	892
	Foot-and-mouth disease	135	...	135	...	..	...
	Anthrax	...	...	...	..	...	...
	Pleuro-Pneumonia (in Goats)	50	...	...	50	...	...
North-Central	Rinderpest	1336	573	66	1145	17	108
	Foot-and-mouth disease	1069	...	1045	24	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	72	...	72	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	3	...	...	...	...	3
Sabaragamuwa	Rinderpest	63	...	7	54	...	2
	Foot-and-mouth disease	1455	...	1445	10	...	...
	Anthrax	..	...	..	...	...	...
	Haemorrhagic Septicaemia	69	4	...	69	...	...
	Rabies (Dogs)	14 †	...	...	4	...	10

* 1 case in a buffalo—Rest sheep and goats. † 1 case—a calf.

G. V. S. Office,
Colombo, 10th December, 1930.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT

NOVEMBER, 1930

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo	85·5	+0·7	74·4	+1·2	77	93	7·7	9·73	21	− 1·94
Puttalam	85·2	+0·4	74·2	+1·6	78	93	5·8	15·25	15	+ 5·18
Mannar	85·9	+1·1	76·9	+1·6	76	84	7·2	1·68	14	− 8·52
Jaffna	83·2	+0·1	74·7	−0·2	82	93	6·8	14·40	16	− 0·18
Trincomalee	84·8	+1·5	74·7	+0·3	78	90	5·8	9·97	17	− 4·21
Batticaloa	84·8	+0·9	74·7	+1·2	78	93	6·0	20·91	17	+ 7·47
Hambantota	86·5	+1·2	73·9	+0·3	76	93	4·8	4·67	14	− 2·30
Galle	84·1	+1·0	74·6	+0·5	80	93	6·6	12·73	22	+ 1·26
Ratnapura	88·3	+2·0	73·1	+0·4	77	93	6·0	10·92	23	− 3·49
A'pura	85·8	+1·0	72·9	+1·2	77	95	7·4	6·70	11	− 4·05
Kurunegala	86·8	−0·2	73·1	+1·2	75	90	7·2	8·05	20	− 3·73
Kandy	83·4	+1·0	68·3	+0·5	74	95	6·8	10·01	20	− 0·49
Badulla	80·1	+0·9	66·2	+1·3	80	97	6·4	14·28	21	+ 3·68
Diyatalawa	75·6	+2·7	60·6	+1·0	87	94	7·0	15·36	23	+ 5·55
Hakgala	69·5	+0·7	56·3	+1·9	88	88	5·8	8·70	25	− 2·91
N'Eliya	69·2	+2.3	52·2	+2·1	82	94	7·5	6·23	24	− 2·86

The rainfall of November was largely of the thunderstorm type, and was distributed erratically, both in the variations between adjacent stations and those between successive days.

In every province some stations were below average and others above. The former predominated in all cases except Uva, though the predominance was not great in Sabaragamuwa and the Western Province. The highest totals for the month were at Udahena (Poonagalla) 36·39 inches, which is nearly double the November average at that station, and Blackwood 33·93. Totals of over 7 inches in a day were recorded at Bibile, Berna (N.W.P.), Batticaloa and Battulu-Oya, while Dooroomadella and Hendon recorded totals of over 6 inches.

A severe storm formed at sea about 300 miles east of Trincomalee on the 26th. Fortunately the centre passed north of Ceylon, and produced but little effect on the Ceylon rainfall, though its effect was well marked in the way in which the wind on the west coast backed from N.E. through N. & W. until on the 29th, when the centre was near Madras, it got round to S.W. At Trincomalee, on the night of the 27th, damage was done owing to the sea rising above its normal level, almost certainly in connection with the same storm.

Temperature, and number of hours of sunshine were above their respective averages. Curiously enough the humidity and amount of cloud were also above average on the whole. Pressure was above average, but the direction of the gradient was less northerly than is usual at this time of year.

A. J. BAMFORD,
Superintendent, Observatory.